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Honor Association Founders During Convention

DURING the Philadelphia convention, the American Foundrymen's association will honor that small group of enterprising and far seeing foundrymen and equipment manufacturers, who met in Philadelphia 32 years ago and founded the association. The members of the A. F. A. in this manner will show their appreciation for the splendid work of that original band in establishing the association on the sound basis that has enabled it to become a leader in the world's foundry industry. Arrangements are being made for a complimentary dinner to those charter members of the association who attend the 1928 convention. The dinner will be held Tuesday evening of convention week at the Manufacturers club, where the first meeting was held on May 12 to 14, 1896. Walter Wood and Howard Evans, president and secretary, respectively, of the Philadelphia Foundrymen's association, and active in the establishment of the A. F. A., will be special guests at the banquet. Arrangements for the dinner and other features at the old timers' reunion are being made by a committee recently appointed by President Utley of the association, and composed of S. T. Johnston, chairman, George C. Matlack, A. I. Findley, William J. Coane and J. A. Steinmetz. A special registration table for the first members of the association will be maintained at the regular registration headquarters in the entrance of the Commercial museum, and further information concerning the banquet will be given out during registration. Here a special badge will be provided as a mark of distinction, and arrangements will be announced for the reunion of the veterans of '96.

S. T. Johnston

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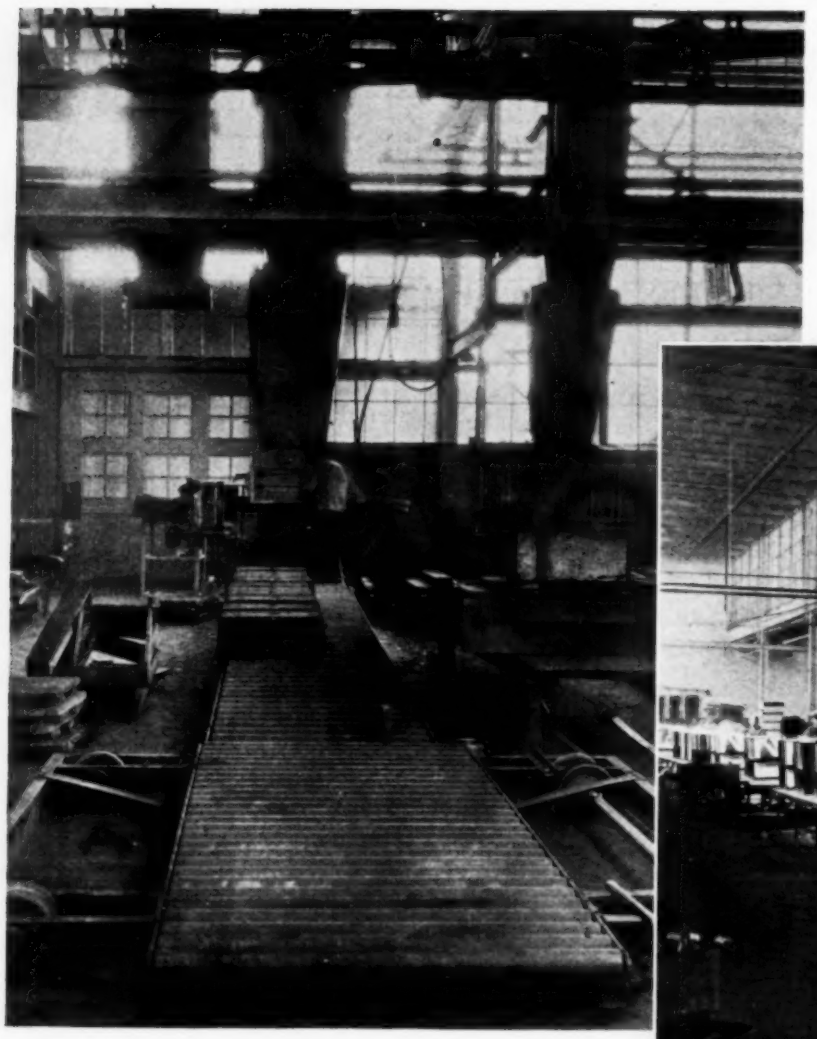
HOW

By Pat Dwyer



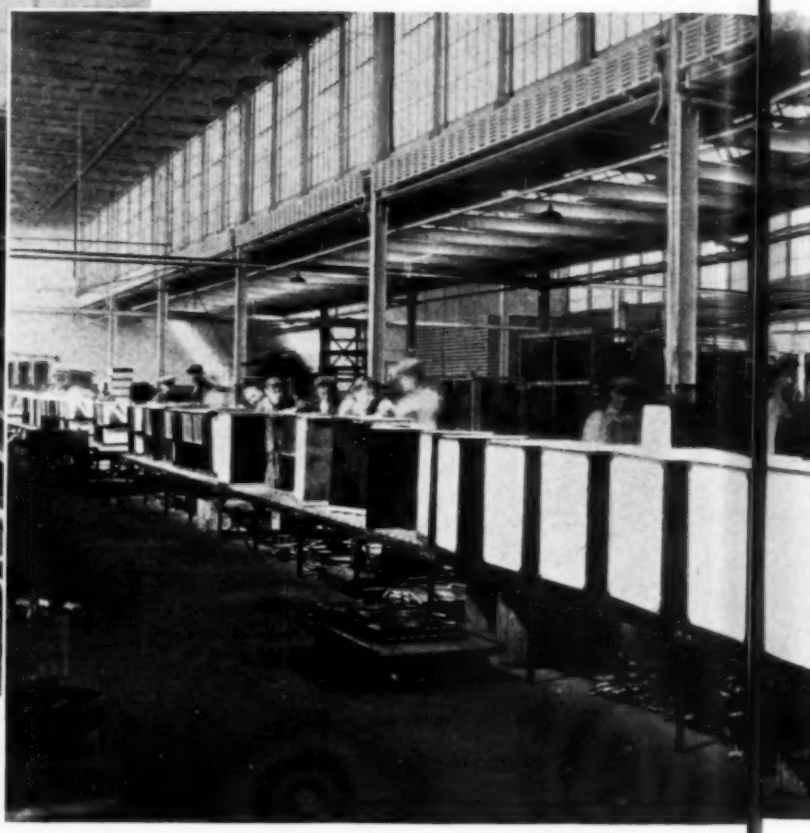


Fig. 1—One of the 40 Molding Units in the Stove Plate Section

ANDREW CARNEGIE is credited with the statement that pioneering does not pay. Like many other statements credited to famous men, this one might convey a different meaning if taken with the context. Unfortunately, since the context never has been published, we do not know if he meant that pioneering *never* pays, or that it does not pay immediately. Even a brief review of the late iron master's life will show that he pioneered to quite an extent. The same review also will show that when he died he was not exactly a charge on the country.

No person will deny that pioneering usually is a slow and costly undertaking and sometimes the pioneer fails to reap a reward commensurate with his efforts and privations. In other instances the process is not so slow and the pioneer lives to see his dreams realized. In exceptional instances his sons take up the burden when he retires and expand the business to still greater proportions. They begin under more auspicious circumstances. They branch out on a larger scale, but they are actuated by the same indomitable spirit that characterized their father.

Recent completion of an immense new stove manufacturing plant by the Peninsular Stove Co., on the outskirts of Detroit marks a new departure in equipment and methods of operation applied to this branch of the foundry industry; but is a logical development for members of a family responsible for starting the industry in Detroit, and responsible in a large degree for placing that city in the front rank as the greatest stove manufacturing center in the world.

Jeremiah Dwyer left without a father at the age of 11 learned the molder's trade and after spending a few years gaining experience in other cities, returned to his native city in 1861 and started a little stove foundry. He worked on the floor during the day and at night he carried his product to the stove dealers of the city in a wheelbarrow. He had health, strength, business instinct and perhaps the greatest attribute

Mechanical Equipment
Aids the Stove Foundry Industry

Fig. 2—One of the Four Assembly Lines on Which Stoves Are Fabricated on a Roller Conveyor

of all, known for want of a better term as good common sense. The business prospered, as business does when based on a combination of that character.

After a few years he was joined by his brother James. Backed by a few prominent Detroit citizens, the company built the Detroit Stove Works. In later years the same interests in various combinations organized the Michigan Stove Co., Art Stove Co., and Peninsular Stove Co.

James Dwyer was the active head of the Peninsular Stove Co. which built a plant on West Fort street in 1881. He died at a comparatively early age, but Jeremiah lived well past the Biblically allotted span of three score and ten and died Jan. 29, 1920 crowned with years and honor and the justifiable reward of a man's work well done. An interesting side light on his character is found in the fact that according to his expressed wish he was borne to his last resting place by eight of his oldest employes, loyal and faithful men who had stood shoulder to shoulder with their chief in prosperity and adversity for many, many years.

Sons of Jeremiah and James Dwyer now are actively engaged in the management of the various stove companies and the amicable relations that always existed between employer and employe still prevail. The entire shop crew from the old Peninsular, many of whom worked for the founder, now are working in the magnificent new plant recently placed in operation about 10 miles distant from the old plant.

This is all the more remarkable since the new foundry is operated on new and radical lines vastly different from conditions that prevail in a branch of the foundry industry more strongly intrenched than any other in tradition and custom. Pioneering in this instance is being tried out on a large scale and is attracting a great deal of interest throughout the stove foundry industry.

Several factors were responsible for the establishment of the new plant. Competition from southern stove interests where manufacturing conditions are more favorable was one. Tremendously increased valuation of downtown real estate rendered the site of the old plant too costly for manufacturing purposes. Incidentally, this property has been sold to railroad interests operating in that vicinity. Expansion at various periods in the company's existence necessitated the erection of additions to the plant. Property restrictions frequently prevented the erection of these additions to the best advantage from an operating viewpoint. Back tracking of materials some times was unavoidable.

When the decision was reached to build a new plant, the first proposition laid down by the management was that it should be laid out on a scale to anticipate future expansion. Also it was felt that the shop should be laid out in a manner to facilitate a steady flow of material from its entry in the raw state to its shipment as finished product.

The second and most radical departure from established practice was to install mechanical equipment for the preparation and distribution of sand and the conveyance of all materials. A natural corollary to this arrangement was the decision to melt iron continuously all day; to keep

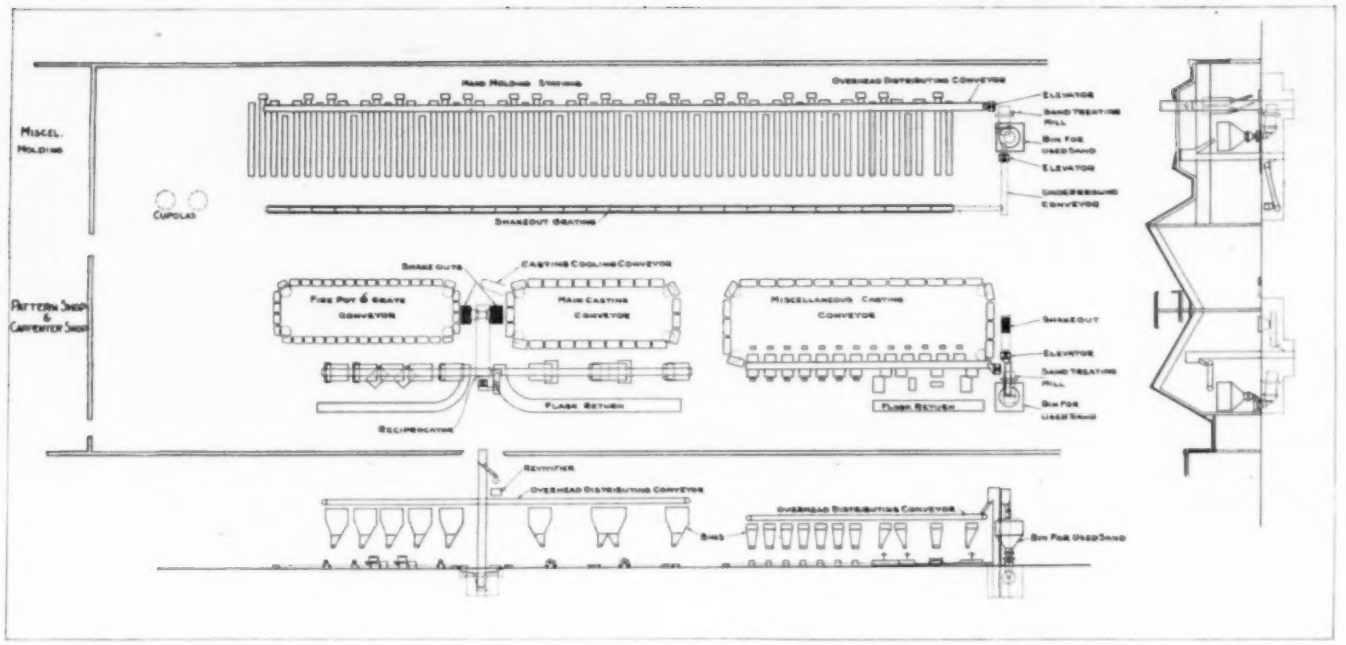


Fig. 3—General Foundry Layout Showing the Relative Position of the Four Molding Units, One for Stove Parts, One for Furnace Firepots and Grates, One for Feed Sections and Radiators and One for Miscellaneous Small Parts

the molders molding all day and to have an independent gang attending to the pouring and shaking out.

Before any definite plan was adopted, executives of the company made an extensive tour of the country and made a first hand study of methods, conditions and equipment prevailing and in use in the most modern and progressive foundries engaged in the production of light and medium weight castings.

The company manufactures a wide range of hot air furnaces and an almost infinite variety of stoves and ranges designed to operate on oil, gas, wood, coal and electric current. On account of the extent to which steel stampings have replaced cast-iron in the stove industry in recent years, the contemplated foundry capacity was not nearly what it would have been at an earlier period. The new foundry is designed for a daily output of 60 tons which may be increased to 80 tons with a few minor adjustments in the present equipment.

The entire group of buildings comprising the plant is housed under one continuous roof with monitors extending the full length to insure ample light and ventilation. These features are supplemented by almost complete glass side and end walls. The remainder of the wall is built of brick. A steel frame supports the walls and roof and the various monorails over which molten iron and other materials constantly are conveyed. The flat roof is covered with gypsum tile. In a word, the building practically is fireproof.

The buildings, yard, railroad sidings and other property inside the present fence occupy 9 acres of the company's 20 acres of land on this site, bounded on the south by the main line of the Pere Marquette railroad and on the west by Burt road, a paved thoroughfare affording direct communication with the city and other communities within trucking distance. A spur from the main line of the railroad enters the property at the east end and opens out into two branches to inclose the group of buildings in a *Y*. One branch extends along the north wall to enter the shipping room on a depressed track where the finished product is trucked directly from the floor level into the box cars. The second branch extends through the stock yard outside the south wall and serves to convey all the raw material into the plant.

This stockyard is roofed and is served by a 5-ton crane made by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. Iron is handled by a magnet. Coke and limestone for the cupolas and coal for the boilers are handled in a specially designed grab bucket made by the Jeffrey Mfg. Co., Columbus, O. Detail and application of this special bucket will be taken up in subsequent articles. The boilers referred to circulate the water in the heating system. Electric current is supplied by the Detroit Edison Co.

In addition to the motor generator set where a certain amount of the alternating current is converted into direct current for the cranes, etc., the

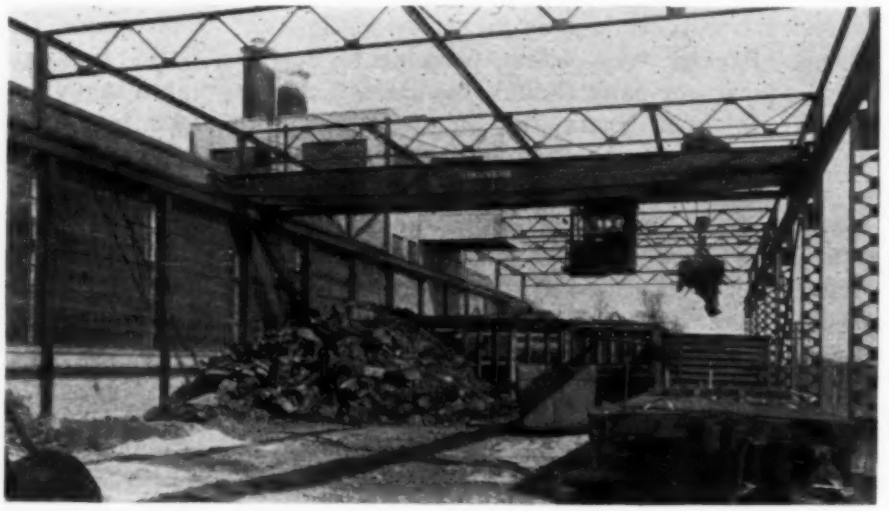


Fig. 4—The Stockyard Is Spanned by a 5-Ton Crane Which Unloads the Iron with a Magnet. Coal, Coke and Limestone Fall from the Cars into a Hopper Under the Track from Which They Are Lifted by a Special Bucket

local powerhouse contains three pumps for circulating water and one small and two large compressors for supplying air for the molding machines and air hoists. The two large compressors, one direct motor driven and the other belt driven were supplied by the Chicago Pneumatic Tool Co., New York. The small compressor was built by the Bury Compressor Co., Erie, Pa.

Two Streams Meet

The foundry and the steel stamping department occupy adjoining buildings at the east end of the group. The castings enter the assembly room through one group of doors and the steel stampings enter through another after first passing through the enameling room. Thus the two streams meet and unite into one flowing over the assembly lines toward the warehouse and shipping room. Stoves are assembled on three lines of roller conveyors. The furnace parts emerging from the sandblast chamber are placed on a power driven plate conveyor where they are ground and trimmed. Afterward they are lifted from the conveyor and assembled on the floor.

The stove parts and small miscellaneous fittings are cleaned in a battery of nine tumbling barrels connected to an exhaust system and made by the Royersford Foundry & Machine Co., Royersford, Pa. Furnace castings are suspended from hooks on an endless monorail made by the Cleveland Crane & Engineering Co., Wickliffe, O. These castings pass through a double chamber sandblast unit made by the New Haven Sandblast Co., New Haven, Conn. An operator stands in each chamber, one facing north, the other facing south. The first man cleans one side of the casting and then pushes the load on to the second man who cleans the other side. A third man keeps a constant supply of castings on the hooks and a fourth man unloads them on to the plate conveyor. The installation and method of operation are shown in the illustration Fig. 5.

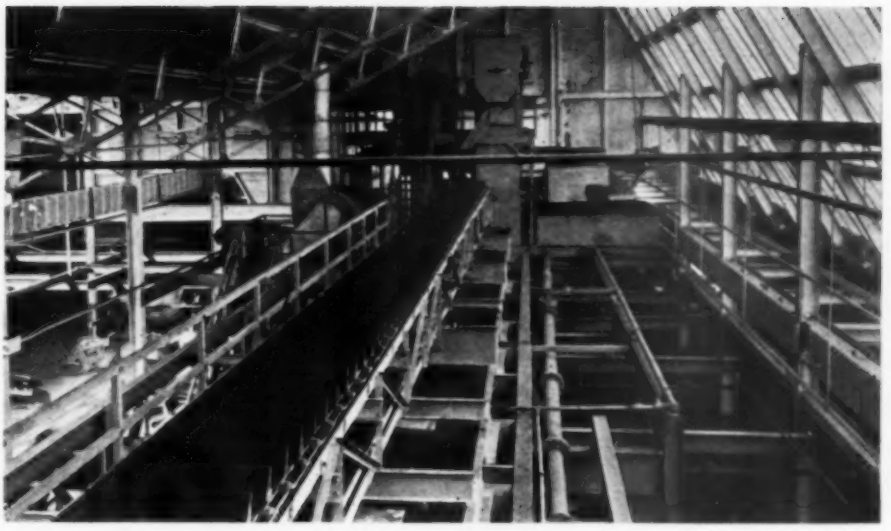


Fig. 6—A Reciprocating Conveyor Leading from the Sand Mixing Unit Distributes the Sand to the Various Hoppers Over the Molding Stations

All the floors in the group of buildings approximately 360 x 900 feet are on the one level thus facilitating the use of a fleet of electric lift trucks. The foundry is floored with brick. Wood blocks are used for flooring the assembly room. The other departments have concrete floors.

Stoves and furnaces are shipped from the stockroom in the west end of the building either by truck or by rail. Trucks come down an incline and back up to a unique form of shipping platform as shown in Fig. 9. The surface of this shipping platform is flush with the floor of the shipping room and also flush with the floor of the truck. The railroad track, as previously mentioned, enters this room at the north side. The track is depressed to bring the floor of the box cars flush with the floor of the shipping room.

Albert Kahn Inc., Detroit designed the buildings working in collaboration with E. L. Dwyer, manager and Lon Kimball, general superintendent. The elaborate system of sand handling, molding, pouring, shaking out and cleaning the castings was worked out, fabricated and erected by the Osborn Mfg. Co., Cleveland. This equipment includes the entire installation of molding machines with auxiliary gravity and power driven conveying units.

The general layout of the foundry, position of the various molding units, sand supply, pouring and shakeout stations are shown in Fig. 3. The floor of this building, 136 x 320 feet, is separated into two main divisions by a main gangway 18 feet wide extending from one end of the building to the other. Space over part of this gangway is occupied by the monorails by which the molten iron is conveyed to the various pouring stations. A passage 14 feet in width close to the north wall serves for a flask and pattern storage. A narrower passage close to the south wall, shown at the top of the illustration serves a similar purpose.

Fig. 5—Furnace Castings Are Suspended from Hooks on an Endless Conveyor Which Carries Them Through a Double Sandblast Chamber

Transfer Table Used

Castings have been divided into four main groups and have been allotted to four molding units designed to synchronize in production. Thus all that section of the foundry located on the south side of the central gangway is devoted to the production of stove parts. Here 40 molders are accommodated in a space 240 feet long and 24 feet wide. This marked economy in space, 6 x 24 feet utilized by each molder, is effected by equipping each man's floor with two gravity roller conveyors slanting in opposite directions. Completed molds are placed on

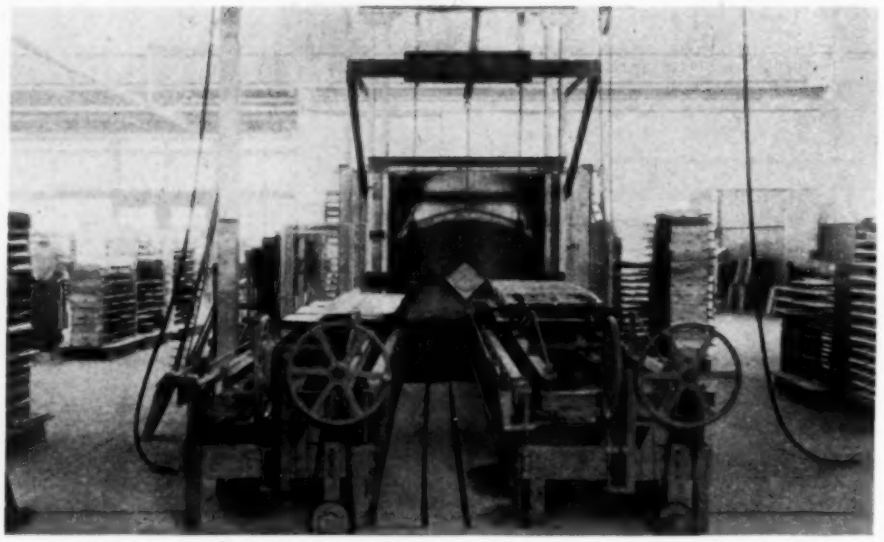


Fig. 7—Two Cars Are Loaded Alternately and Placed in the Enameling Oven Where They Remain at a Temperature of 1500 Degrees Fahr. for Approximately 25 Minutes

one and are poured when they arrive at the low end. The empty flasks are placed on the high end of the adjoining conveyor and roll toward the low end close to the molder's station.

A 10-foot gangway separates the ends of the various conveyors from the continuous shakeout grating and provides a safety factor in the event that through any cause, molten metal is spilled on the floor during the pouring operation. This gangway is spanned by a section of roller conveyor mounted on four low wheels which carry it to any desired point on tracks laid flush with the floor.

The poured molds are pushed in turn upon this movable conveyor section. They are dumped by hand over the long shakeout grating. The sand falls to a belt 24 inches below the grating at the bottom of a long, continuous hopper. Flasks and bottom boards are placed on the return conveyor. Castings are loaded into steel boxes mounted on skids and taken by lift truck to the tumbling barrels. Gates and sprues are collected and transported in a similar manner to where the charges are made up for the cupolas.

A belt 24 inches wide and extending under the floor 260 feet carries the sand from under the shakeout grating to a point 12 feet west of the end of the grating. Here the sand falls upon a short inclined belt traveling at right angles which in turn discharge the sand into the boot of an elevator. A magnetic pulley at the end of the first belt removes metallic inclusions.

Sand from the elevator falls upon a circular plate 10 feet in diameter where it is spread out thin, cooled, aerated and slowly discharged over the edge by a revolving arm into a storage hopper.

This storage hopper is the balance wheel of the sand preparation system. It is the device through which the sand mixture is controlled. Through an adjustable gate at the bottom a definitely measured volume of sand is discharged in a steady stream into a roller mill. New sand is loaded into a small hopper located a little above the floor level. A revolving center in this hopper provided with adjustable slots, discharges new sand in any given proportion into the same mill. Thus the mixture may be changed instantly at any time to maintain bond and permeability.

A combination of new and old sand falls from the roller mill outlet and passes thence into the boot of a second elevator which takes it aloft and discharges it upon a long flight conveyor extending over the long line of hoppers suspended above the molding stations. Suitable plows deflect the sand into any of the forty 2-ton hoppers.

An ingenious clamshell gate and long steel apron are attached to the bottom of each hopper. The apron is hinged at the top and when not in use, hangs plumb and clear of the flask. When the molder has covered his pattern with sieved sand, he pulls the bottom of the apron forward with one hand, releases the gate by pulling a light steel rod with the other hand and his flask is filled instantly with sand. The gate closes automatically when the hand rod is released.

All the molds in this section are made in the ordinary manner in hinged wood flasks. Metal patterns are mounted on follow boards and the sand is rammed by hand. Highly skilled molders are employed exclusively.

A different set of conditions prevails on the north side of the central gangway where hot air furnace castings are made on three independent molding units. Fire pots and grates are made on the first. Feed sections and radiators are made on the second. All the miscellaneous small parts are made on the third. The first and second units are equipped with comparatively heavy molding machines operated by compressed air. The third unit is served by a double battery of smaller, air-operated squeezer machines on which the molds are made in snap flasks. A more detailed description of the molding methods will be presented in subsequent articles.

Molds from the different machines are placed on rectangular conveyors as shown in the accompanying illus-

Fig. 8—One Corner of the Extensive Pattern Shop Containing the Metal Working Machinery. The Stairway at the Right Leads to the Drafting and Designing Room

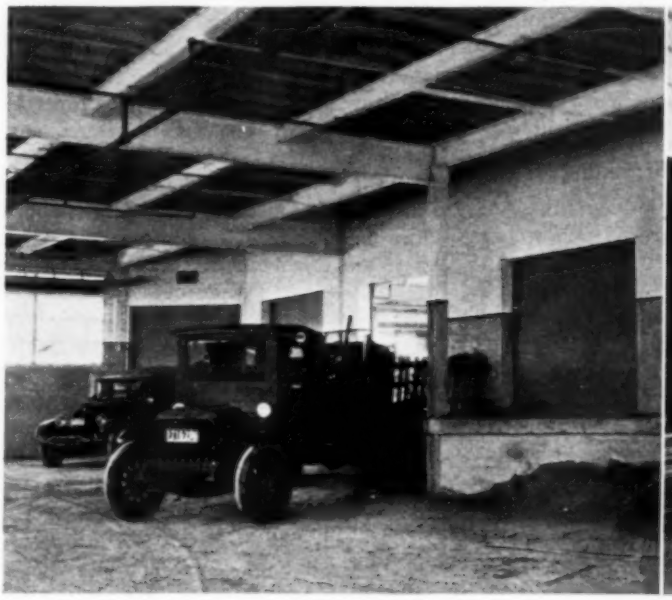
tration Fig. 3. The first conveyor carries 34 plates, 32 x 72 inches. The second has 28 plates, 36 x 63 inches, and the third for the small molds carries 38 plates, 30 x 72 inches. The plates are mounted on shoes that slide on the rails and are equipped with rollers on the inner edge for guiding them past the corners. Each conveyor is driven by an individual motor through a sprocket and chain.

The sand handling unit for the small, miscellaneous casting section is similar to that for the stove plate section previously described. The molds are shaken out by hand over a grating in the floor at the center of the each unit, but the sand from both units is conveyed to a single sand treating plant where it is reconditioned and then distributed again to the various hoppers located above the molding machines. A revolving type mixer made by the Jeffrey Mfg. Co., Columbus, O., is utilized in this installation instead of the circular plate and storage hopper employed in the other two units.

The sand preparation plant as may be noted in the illustration Fig. 3 is located between the two sets of hoppers serving the first and second molding units. Five, 20-ton hoppers supply sand to the molding machines

Ohio State Foundrymen Hold Meeting

Members of the Ohio State Foundrymen's association held a meeting March 26 at the High Noon club, Cleveland. Henry Turner Bailey, director, John Huntington Polytechnic institute, and dean of the Cleveland School of Art, spoke briefly on the establishment and aims of the Huntington Polytechnic institute. He was followed by John Wise, assistant to the general sales manager, Osborn Mfg. Co., Cleveland, who spoke on "Design for Foundry Practice." Mr. Wise also is an instructor in the



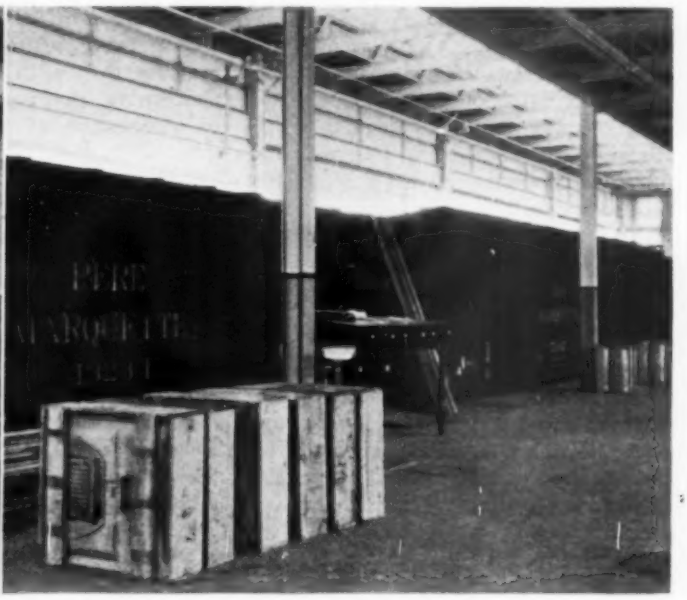


Fig. 9—Trucks Are Loaded in an Extension to the Shipping Room Where the Floor Has Been Lowered a Sufficient Distance To Bring the Platform of the Truck Flush With the Floor of the Shipping Room. Fig. 10—A Depressed Track with a Capacity of Three Freight Cars Is Located at the North Side of the Shipping Room

west end. This unit has a capacity of 60 tons of sand per hour distributed through 12 breeches type hoppers.

Molds from the first and second conveyors are made in cast steel flasks and are too heavy to be lifted by hand. Air hoists made by the Curtis Mfg. Co., St. Louis, and suspended from a monorail are employed to handle these flasks. An air-operated plunger in a cylinder mounted horizontally pushes the mold from the bottom plate upon a steel grating violently agitated by a jolt machine located under each end. The action of these machines is not synchronized, therefore the eccentric agitation of the grating is intensified.

Flasks are lifted and placed on roller conveyors which carry them back of the molding machines. Castings are placed on hooks suspended from a chain which carries them above the roof and then deposits them cooled in the vicinity of the sandblast chamber in an adjoining department.

A shakeout grating is provided for in the first unit. Machines in the second unit are served by two, 20-ton and one, 30-ton hopper.

Prepared sand is discharged from an elevator on to a reversible reciprocating conveyor driven by a single, 10-horsepower motor. This conveyor may be driven in either direction to convey sand either to the hoppers on the right or on the left. It extends 84 feet in both directions from the center.

This is the first of three articles by Mr. Dwyer on the new plant of the Peninsular Stove Co. The others will follow in subsequent issues.

The J. C. Miller Co., 250-252 Pearl street, Grand Rapids, Mich., for many years dealer in polishing, plating and buffing supplies and equipment, recently has added a foundry division to its business. The company will handle foundry equipment and foundry supplies of various kinds in the state of Michigan.

Huntington school which provides evening courses in a number of professional lines, and his talk described the work of the course he teaches.

Mr. Wise pointed out that except in a few large plants, there is no correlation between machine design, pattern shop and foundry. The designer having no conception of molding difficulties follows his own ideas in designing a machine. His drawings are turned over to a patternmaker who likewise has no knowledge of foundry practice, and he makes the pattern according to his lights. Finally, the foundryman receives the pattern and he has to make changes so that the casting may be made as economically as possible.

According to Mr. Wise, many of the changes that the foundryman has to make, could be avoided if the designer understood foundry practice. Mr. Wise outlined the work taught in the course which is intended to lead to co-operation between designer, patternmaker and foundryman.

Expounds Principles
OF SUCCESSFUL CUPOLA OPERATION-I

By John W. Bolton

SINCE shop conditions vary, obviously it is impossible to devise a generally applicable set of rules for cupola operation. Coke and stock available, demands of the class of work, peculiarities of the furnace and blower installations and many other factors make a universal standard practice only an hypothetical ideal. However, the principles underlying successful operation remain the same. Study of each cupola, and application of these principles, will result in improvements, both in quality and economy.

Conditions today are quite different from those of 25 or 30 years ago. Mixing by fracture was prevalent, high production machining schedules were rare, close size tolerances were the exception and few castings had to meet high-test specifications. Today quality demands are keener and production standards are higher. Notwithstanding this, many foundries still are struggling along with archaic cupola practice.

The progressive superintendent demands hot, live iron, uniform in temperature and composition, melted reasonably fast, with economy in material and labor. The operation should be standardized; it should give uniform results, and be sufficiently flexible. With a little study and competent metallurgical help, these demands can be met in a satisfactory manner.

Inspection of the cupola lining on the morning after a heat often will indicate to the experienced eye much concerning the previous practice and be suggestive of improvements.

At the Beginning

The drop should be examined first. Iron should be separated and weighed. Melting rates often are figured on metal charged rather than on net metal melted plus loss, *i. e.* metal charged, minus drop. Of course, this latter is the correct figure to use when calculating melting rate. The dropped stock should be classified roughly to see whether the relative proportions of different metals in the mixture, pig, scrap, steel, etc., are coming through as charged. Also, it is well to get in mind a rough idea of the proportion of coke left. This coke undergoes great volume shrinkage, even though wet down thoroughly. The bed as charged, say 30 inches above the tuyeres, sinks before the blast goes on, due both to burning during the soaking period and crushing down caused by the weight of stock above. In cupolas operating with correct bed height, segregating the bed coke may result in an apparent bed of 4 or 5 inches rather than an effective bed of 24 inches.

Iron splashed around and dropped molten under the cupola may mean that all the metal was not drained out on the last tap, it may indicate an improperly shaped bottom, or a tap hole above the bottom. Iron in the slag bed means that a careless tender allowed the metal to run out of the slag spout. Some tenders use the slag spout as a gage by which to tap, usually indicative of sloppy practice.

Unless the drop has been particularly heavy, some slight bridging of slag will appear just above the tuyeres. This bridging usually is greater on a boshed cupola. A heavy bridge extending far out toward the center of the cupola is a good indication that slagging is not conducted properly. Trial of more stone is advisable. If

IN A series of three articles of which this is the first, J. W. Bolton presents suggestions for practical cupola operation. These suggestions in most cases are accompanied by statements of the principles involved. The principles apply in any foundry, but the specific directions are not intended to be complete in every detail, nor are they necessarily the last word in existing practice. They are simple and have given excellent results over a wide variety of castings, in different foundries and on various makes of cupolas. Readers should bear in mind that operation for greatest efficiency differs from operation for maximum temperature. Maximum melting speed may necessitate the sacrifice of other desirable features. Obtaining low carbon may involve loss of temperature and fluidity.

The author will discuss patching of the melting zone, making the bed, putting in the breast, placement of the coke and metal charges and the size of these charges. He also will describe the advantages obtained by measuring air by volume.

The author, J. W. Bolton, chief metallurgist, Lunkenheimer Co., Cincinnati, has had an extended experience in his chosen field and has been a frequent contributor to the technical press and to the transactions of the American Foundrymen's association. He has been appointed to prepare the annual exchange paper to be presented before the International Foundry congress to be held in England in 1929.

the bridge extends out only a few inches, conditions may be assumed to be all right in this respect. While a bosh has certain disadvantages, a slight recession at the tuyere zone minimizes the tendency for iron, coke and slag to work into the tuyere box. Some claim that air is driven more effectively to the center of a boshed cupola. Extremes in bosh are inadvisable.

Overhanging slag is chipped down, with proper care to avoid pulling out large pieces of lining with the slag. Slag that is tough and hard to remove, probably is low in lime. A high lime slag, wet down from the charging door, is friable and easily removed.

With the bridge chipped out, the lining may be inspected thoroughly. Above the tuyeres all coke, blisters, loose chunks, etc. adhering to the wall should be removed. A clean background is the first essential to good relining.

Scoring above the tuyeres suggests the zone of highest temperature at the wall. The scored area indicates the bed height, the balancing of the coke charges, the air supply, and the tuyere arrangement. A clearly defined melting zone should be cut in for a height of 4 to 8 inches on a nearly even level horizontally. Absence of a scored melting zone generally means improper coke ratios between charges. The effective bed height was not held constant at any one point. It may indicate an excessively high bed. If the melting zone line is uneven horizontally with irregular scoring, the air flow probably is not uniform. This may be due to the air pipe entering one side of the cupola straight instead of tangentially, to uneven arrangement of tuyeres, to blocked tuyeres, to uneven charging, to limestone thrown irregularly around the lining, or to irregularities in the contour of the cupola lining, purposely built into the furnace in accordance with some melter's wild idea. Since uneven scoring is an indication of irregularities in furnace practice, the possible causes should be investigated and faults remedied.

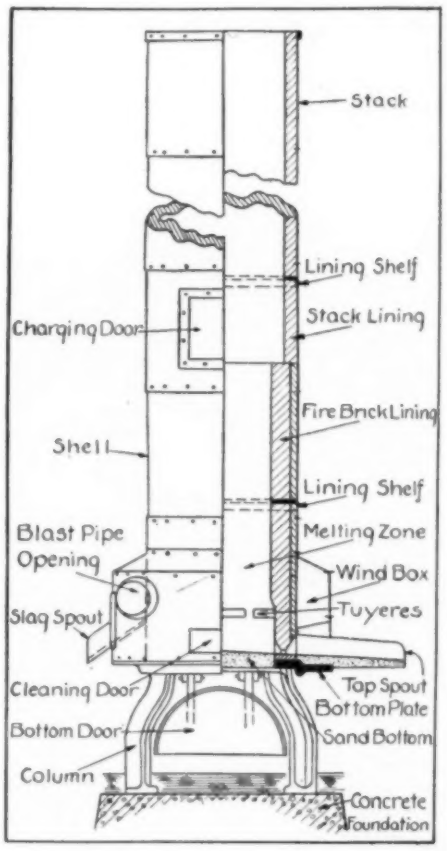


FIG. 1—OUTLINE DRAWING OF THE CUPOLA SHOWING THE PRINCIPAL FEATURES OF CONSTRUCTION

Patch the Lining

Patching the melting zone with brick every day is expensive in material and time. Ordinary firebrick are hardly refractory enough for severe cupola conditions. The customary practice is to use a mud daubing to repair the ravages of each heat. The melting zone only is relined at long intervals. Too often muds too high in clay are used. A mud properly made from clay and silica is more refractory than ordinary firebrick. Three important points to keep in mind are:

(a) The lining must resist the abrasion of the descending stock as well as the action of heat and slag.

(b) It is desirable to retain a slight natural belly at the melting zone.

(c) Adjust the patching so that it is just enough to replace the amount burned out each day. With the proper refractory mud too much patching will build out and lessen the effective melting area of the cupola.

Varieties of daubing mud in use nearly equal the number of foundries. The following mixture has proved satisfactory:

1 part fire clay, the more colloidal and refractory, the better. 1½ to 2 parts refractory silica sand (waste sand blast sand is well adapted for this purpose providing it does not carry too much scale.)

This is mixed in a muller, with just enough water to make a stiff mud. When properly made it is highly refractory and possesses just enough sticking power.

River sands often contain lime, which is undesirable. Molding sands usually are not sufficiently refractory. Coarse sands and ganisters may not give a mix which resists abrasion. If used they must be put on hard—then they are good. High clay mixtures are not refractory enough and have high shrinkage. Unfortunately, many foundries cling to a straight clay mud mixture in place of sand. Some foundries use ground silica brick.

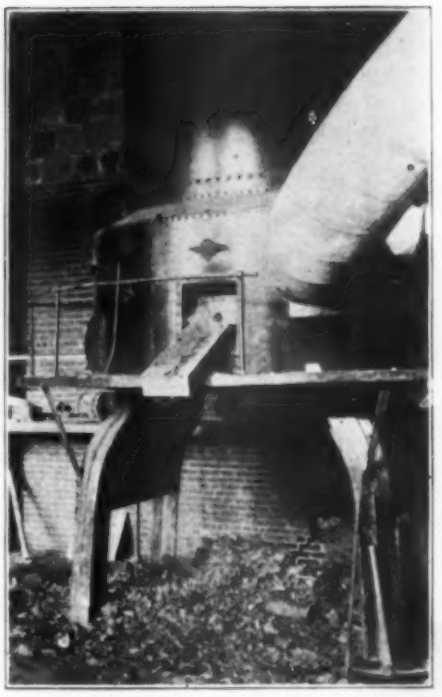


FIG. 2—THE DROP SHOULD BE EXAMINED AND THE COKE AND IRON SEPARATED

Before putting on the mud, the walls should be examined and any deep penetrating holes plugged tight with stiff mud. The walls then are wet down with a brush, the mud thrown on firmly and the mud then is worked out fairly smooth with the hands or a trowel.

Raise the Doors

A slick, smooth finish is neither essential nor desirable. A lot of excess water is needed to get such a finish and then the mud will peel every time. The ordinary cupola only requires about 1 inch of mud at the melting zone, running to a beveled edge some 3 feet above the tuyeres. In many instances a 1-inch clay daubing up to 2 feet above the tuyeres is sufficient for 5 days of the week. On the sixth day it is extended up to 4 or 5 feet and baked with a fire over Sunday.

A monolithic lining offers certain advantages provided it is rammed in tight and the heat is sufficient to sinter it together. The first cost of putting in such a lining is high due to the labor and equipment involved. The well must be kept tight. A semi-monolithic lining works well in this part.

A number of devices are available for raising bottom doors into place. A laborer can raise the doors of a small cupola in a few minutes. Supports must hold the doors securely. Foundations under the bars should be hard. Loose sand should be scraped

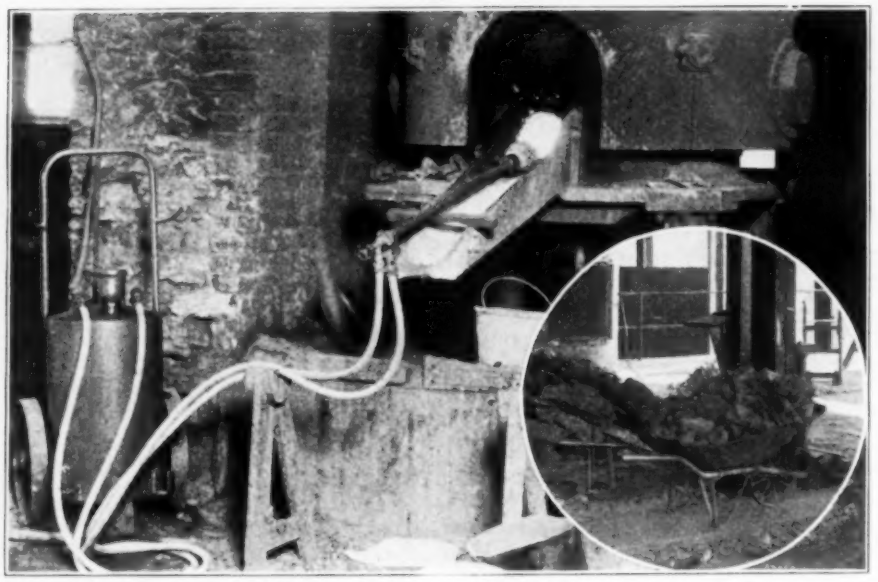


FIG. 3—AN OIL-BURNING TORCH ASSISTS IN IGNITING THE BED THOROUGHLY. FIG. 4—INSERT—THE BED COKE SHOULD BE COMPOSED OF LARGE PIECES

away, and bar rested on small steel plate on the concrete or iron block foundation. After the last bar is wedged in, the other or others should be inspected. Driving the last bar may loosen the first ones.

Bottom sand should be fairly dry, preferably rather open, mostly burned sand bonded with about one-third strong new sand. It should be tucked around the edges to a fillet and rammed fairly hard all over. Wet sand rammed too hard is likely to cause boiling and parts of the bottom may come up. A wet bottom also may cause dull iron on the first tap. All parts of the bottom should slope slightly toward the tap hole.

Wood pieces for igniting the bed should be laid criss-cross on the bottom to form a lattice work through which air can pass freely, but so arranged that subsequent wood and coke cannot cut the bottom sand. A number of longer pieces are placed upright around the sides, to protect the daubing, with shorter pieces in the center. After adding several forks of coke, a light is applied at the bottom. Some of the peep holes or the clean out doors are opened to give draft. Some foundries light off with an oil burner, in which case channels made with boards or coke should be laid so that the flame lights off over the whole bottom. More coke is added later to a point somewhat above the tops of the tuyeres. While this is burning, pieces of coke should be added to stop up holes and even up the first bed. The exact placing of this first bed and properly filling it in is one of the prime essentials to a successful heat, and particularly essential to getting hot iron right at the start. All bed coke should be in as large pieces as it is possible to obtain.

After the first bed has burned through pink and even, (not white on one side and black on the other!) most of the air inlets on the cupola wind box are stopped. One or two are left open to prevent possible gas explosions. The remainder of the bed coke then is added evenly.

Proper height of bed depends on a number of factors. Usually it ranges between 24 and 36 inches above the top of the tuyere openings as measured by a rod let down from the charging door. Some coke crushes down more than others and therefore demands a higher bed. The greater the distance from tuyeres to charging door, the greater is the pressure on the bed. A high blast will raise the melting zone, hence change the proper height for the bed. These and other factors make the adjustment of bed height a matter for individual attention, if maximum results are to be attained. Almost any cupola will operate on a 30-inch bed on a pig and scrap charge, so this is a safe height with which to start.

To Get Hot Iron

To get extremely hot iron right from the start, it is advisable to have the bed in and charging started about two hours before the blast goes on. Radiant heat warms the bottom, and the stock is preheated by the hot gases.

A wide variety of opinions exists on the subject of charging. Fairly successful results can be obtained under widely varied charging systems.

The foundryman wants hot iron, uniform in composition and in temperature, melted reasonably fast, with consistent fuel economy and minimum fuss in cupola manipulation. Charging is a big factor in obtaining these results.

Uniformity in composition and in size of the raw stock charges undoubtedly help in attaining uniformity in composition of the molten metal and, to a certain degree, to uniformity in temperature. Obviously, it is impractical to obtain stock exactly fulfilling these ideals, but reasonable care should be exercised to avoid the opposite extreme. Big, heavy slabs should be broken. Where they must be used they should be placed on end, not flat, in the center of the cupola. Expense involved in breaking pig iron is justified only in special conditions and does not seem necessary in attaining good results. Fine, thin scrap naturally melts faster than heavy chunks. Steel, in the form of rails and similar sections, gives no trouble in melting provided it is charged properly. Use of flashings and similar thin scrap is questionable unless extremely low price more than compensates for heavy melting loss.

Weight of Charges

Coke should be hard, dense, good sized, and not excessively high in ash. The coke charges above the bed should be regulated to maintain a constant melting zone. The amount varies according to the stock and the local conditions. This proportioning is best determined by a little work with an optical pyrometer, observation of melting rate at various places through the heat, inspection of the

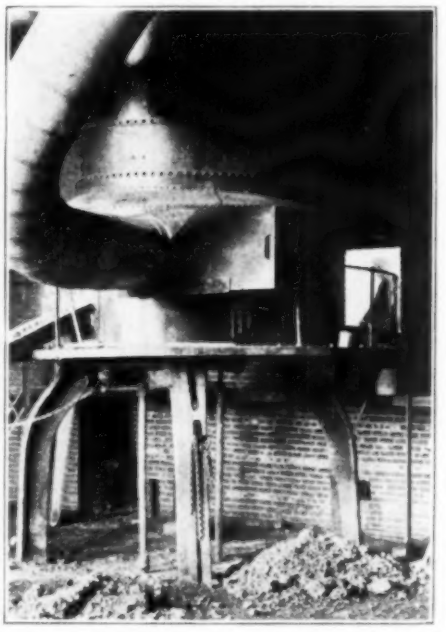


FIG. 5—SOLIDLY PLACED PROPS ARE NECESSARY TO SUPPORT THE BOTTOM DOORS OF THE CUPOLA PROPERLY

lining, and study of the drop. Usually, each charge of iron in pounds should be 0.60 to 0.75 times the cross section of the cupola in square inches. A coke ratio of 1 to 10 pounds iron in the charges is nearly right for cupolas 15 feet or more from bottom to charging door. The melting capacity of the properly operated cupola is somewhere around 8 pounds for each square inch of cross sectional area. It is assumed that 30,000 cubic feet of air is necessary to melt one ton of iron. If connections are tight, this figure should not be exceeded greatly or trouble may be encountered. Good results sometimes are attained at 24,000-26,000 cubic feet of air per ton melted.

Assume a cupola 60 inches inside diameter; then the area is πr^2 or 3.14x30x30=2826 square inches. The maximum charge advisable is 2100 pounds, but 1500 pounds would be as good or better. The coke between charges should be 200 pounds. This is equivalent to about 7 good forkfuls. The melting rate is about 11 or 12 tons an hour. Then the air per minute on the volume gage should be 30,000 x 12, 60, or 6000 cubic feet.

Carefully watching the heat and checkup with a temperature measuring device is necessary if ideal hot metal is to be melted quickly and efficiently. Any dub can read a handbook and get molten iron out of a cupola. Considerable skill and study are necessary to get superheated metal. Patient accumulation and interpretation of data plus careful workmanship and attention to details will pay in results attained. The good old days are gone forever, and with them the careless method and mysterious manipulations.

From point of view of temperature and economy, the coke should not burn before it reaches the melting zone. This ideal never is realized fully in every day practice. The first reaction, air to coke, oxygen to carbon is

$O_2+C=CO_2$, plus, heat (97,200 gram cal. per mol.) or oxygen, plus, carbon changes to carbon dioxide plus heat.

For theoretical efficiency the percentage of carbon dioxide in the exhaust gases should be about 19 per cent.

Unfortunately, the carbon dioxide, on passing over incandescent coke (carbon) higher in the stack is reduced, or—expressed in another way, the coke is oxidized according to the equation

$C + CO_2 = 2\ CO$ plus, heat (29,160 gram. cal. per mol.) Carbon, plus, carbon dioxide changes to carbon monoxide, plus, heat.

This carbon monoxide gas passes up the stack to burn with a bluish flame when it meets sufficient air (oxygen)

$2\ CO + O_2 = 2CO_2$ plus heat (68,040 gram. cal. per mol.) Carbon monoxide plus oxygen of the air changes to carbon dioxide plus heat.

This results in a heavy heat loss, the formation of CO taking away much of the life of the coke yet generating only about one-third of the heat down in the stack. Carbon monoxide is burned up near the charging door and thereby wasted. Not only is there a loss of heat due to formation of carbon monoxide, but the author also thinks this reaction prevents sharp and vigorous reaction, with its additional superheat, at the melting zone.

Develops Core Box

By W. C. Lang

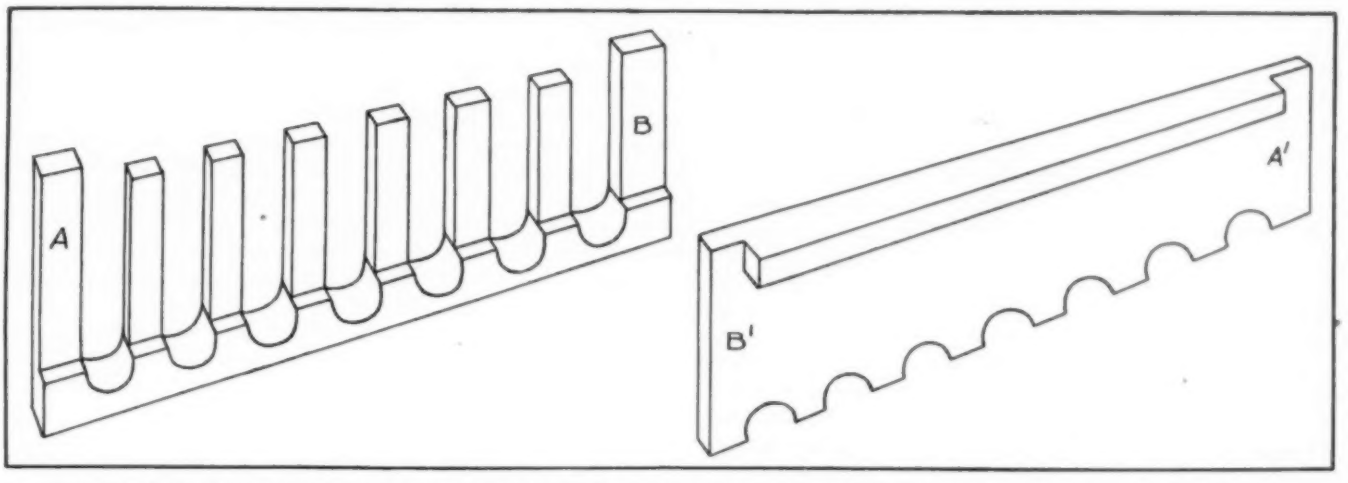
References to new ways of doing old jobs reminds me of one of my own experiences. Through some peculiar quirk in human nature the average man seems to have no hesitation in picking up another man's idea and claiming it as his own.

About 15 years ago the firm for which I was working found it necessary to figure a little closer than ordinary on a job that required an immense number of small cores with stopoff tail prints. I was sent to the core room to study the job and develop a more rapid method of making cores. The corebox shown in the accompanying illustration was the result.

For clearness of description the face side of each half of the box is shown in the illustration. When the box is assembled these two faces touch each other. This will be readily apparent if you swing the part to the right on an imaginary axis at the near end and then place *B*1 on *B* and *A*1 on *A*. The edge with the semicircular openings in the part to the right fits upon the ledge shown among the corresponding grooves in the part to the left. The narrow shelf in the right section rests on the top of the upright members in the left section. The job at each end of the shelf fits snugly inside the upper end of the high post at each end of the left part. The ledge holds the two parts of the box in correct relationship one way and the shoulders on the shelf hold the parts in position the other way.

The peculiar part of the story and the reason I refer to it now is that about 5 years after I had made the box, a writer from Buffalo, sent a description of it to THE FOUNDRY. He did not claim he had invented it, but simply referred to it as a good method for making a slide corebox.

Later I worked in a shop where the master mechanic had worked as a patternmaker at the time the first corebox was made. My former boss had supplied a drawing. When a somewhat similar corebox was required this master mechanic came around to show me how to make it and to tell me how the inspiration had come to him in the first place. Verily this is the age of Bull!



PERSPECTIVE VIEW FACE SIDE OF TWO PARTS OF A MULTIPLE COREBOX FOR MAKING SMALL ROUND CORES

Gray Iron Institute

Designed to Meet Vital Need

By John L. Carter

AT A meeting held in Pittsburgh March 13, attended by 54 gray iron foundrymen, and those deeply interested in the industry, representing 27 foundry centers in 14 states, a resolution unanimously was adopted to form a national organization of gray iron foundries, to be called the Gray Iron institute. A call has been issued for all interested gray-iron foundrymen to attend a meeting to be held at Philadelphia on May 18, during the week of the American Foundrymen's association convention definitely to organize this institute.

An organization committee of 15 was elected at the Pittsburgh meeting to formulate a definite program that will be presented to the coming meeting at Philadelphia, at which a large number of gray iron foundrymen from all parts of the country undoubtedly will be present.

This project has been discussed in the trade papers and among foundrymen generally for some time. Some may have regarded it as a lot of futile talk, an idle dream which was impractical and would never be realized. But there is no doubt now that the project has aroused widespread interest, powerful backing, and sufficient momentum to carry it through to a successful conclusion. In the writer's opinion, the Gray Iron institute undoubtedly will be launched at the coming meeting at Philadelphia.

The activities of the institute will have a far-reaching effect upon the whole gray iron industry, and upon the business of each and every foundry center and individual foundry in the country.

Accordingly every foundryman is concerned directly and wideawake castings producers should give this project time and attention. They should do some constructive thinking and endeavor to contribute sound advice and help.

It is not hard to outline the weaknesses of the gray iron industry, nor to think up possible measures which a national association could take to improve conditions. With adequate financial support, it will be easy to map out an ambitious program to attack the problem from all angles.

JOHN L. Carter, author of this article, is president of the Newark Foundrymen's association, and was the official representative of that association at the Pittsburgh meeting of the Gray Iron institute which was held March 13. Mr. Carter is a member of the organization committee of the Gray Iron institute, and is associated with the Barlow Foundry Inc., Newark, N. J.

It plainly is apparent that the financial support for this work at present is an unknown quantity. The amount of support forthcoming will depend upon how the initial program appeals to the individual foundryman. It is not easy to interpret correctly the attitude of the individual foundrymen in various localities unless an expression of opinion is offered by a great many foundrymen.

Therefore it is hoped that you who read this article will study this problem and give us the benefit of your advice, based on your own needs, your own conception of what should be done and the extent to which you are willing to support the work financially. Send your views to Dan M. Avey, temporary secretary, Gray Iron institute, 1213 West Third street, Cleveland, or come to the meeting prepared to express them at Philadelphia on May 18.

The chief weaknesses of the gray iron foundry industry may be summarized in the writer's opinion as follows:

1. Decrease in demand for gray iron castings due to:

   Replacement of gray iron castings by other metals, such as:

   a. Steel or malleable castings
   b. Steel stampings, forgings, welded steel, other fabricated steel products.

   Lack of high standards of quality or uniformity of quality in product of the average foundry.

   Lack of national advertising or scientific merchandising, whereas competing products have been pushed by vigorous advertising campaigns through national associations with large budgets.

   Hand-to-mouth buying.

2. Overcapacity.

   This may have been due to expansion during war boom. Many foundries doubled or trebled their capacity and many manufacturing plants built their own foundries. When the manufacturers' own business decreased after the boom, these manufacturing foundries entered the jobbing field in competition with existing jobbing foundries. It has been generally stated that the gray iron foundries on the whole, are running at only about 50 per cent capacity. Half the foundry capacity of the country could be shut down and the other half could take care of present demand.

3. Excessive Competition Due to Widespread Prevalence of Unsound and Unscientific Business Methods, such as:

   Variation in trade customs and code of business ethics.

   Ignorance of costs and lack of uniformity in cost systems.

   Ignorance of trade and market conditions.

   Lack of a spirit of friendliness

and co-operation among competing foundrymen.

Every gray iron foundryman must recognize the truth of this summary of the adverse conditions now prevailing in the gray iron foundry industry. The individual foundry by itself can do little to alleviate these conditions. The only way to bring about any material improvement is by co-operative effort on a national scale, with the whole-hearted support of a large majority of the gray iron foundries. If this support is secured, and if a reasonable budget can be financed, there is no doubt that conditions will be greatly improved. The results secured by national associations in other industries, some of which have faced similar conditions, proves that the gray iron industry can get results by following their example.

Gives Activities

The possible activities of a national association fall naturally into four main divisions which are listed here in the order in which it seems to the writer that they should be taken up.

1. The collection, from all possible sources, of existing information useful to gray iron foundrymen, sifting, summarizing, and putting it in such form that it can be understood by the average foundryman and applied to the operation of his own foundry.
2. The broadcasting of this information in a condensed readable form to member foundries.
3. The use of publicity designed to educate the public, the engineering profession, and users of castings to an appreciation of the merits of gray iron castings.
4. Research work planned to discover new methods of improving the quality, reducing the cost, and merchandising the product.

It is important to get a clear conception of this sequence of steps which should be followed in trying to improve any of the various adverse conditions which demand attention.

For instance, the lack of respect for gray iron castings on the part of engineers and users is due in many cases to the mediocre quality of the castings produced by the average foundry, and their lack of uniformity and dependability. Castings for special purposes or with strict specifications frequently require a high degree of technical knowledge in the producer. When these are purchased from an ordinary jobbing foundry without special technical knowledge and experience, the results frequently are unsatisfactory, or if they are satisfactory on the first lot, it may be due more to good luck than good management, and the second lot may be poor. If the pattern for an identical casting is sent to ten different foundries, the customer probably will get ten different varieties of metal, some good, some poor. When the engineer finds that the quality varies, and cannot be depended on to be uniformly up to specifications, he loses confidence in gray iron and turns to some other material.

If the average gray iron foundry was familiar with the best existing practice, and if this knowledge was intelligently applied, the quality of castings produced would be tremendously improved and a great deal of the old prestige of cast iron could be won back again. Also, foundries making an ordinary grade of castings would not be so ready to tackle special jobs which they knew they could not produce with entire satisfaction to the customer.

So the first step in regaining the confidence of the public is not the discovery of new methods of manufacture but the wider and more intelligent application of the best existing information.

Collect Information

This should be kept in mind when research on a national co-operative scale is proposed. Some immediately will think of an expensive program involving the employment of experts to discover some new marvelous high-test cast iron, which the average foundry will be unable to use profitably in its own business, and which may not come into ordinary commercial use for many years. Some will say, "What good is this research work to me?"

No such expensive or impractical program is contemplated at this time. The first step in any practical research program is the collection of existing information and broadcasting it to the foundries. This alone is a big job. The second step is a careful survey of existing information to find out where further research is needed and likely to produce results, for the ordinary foundry or the industry as a whole which will make it worth the cost. Only then would any considerable expense for direct technical research work be justified. Presumably the research committee, before going ahead with direct expense for original research, should submit their plan to the membership and get their opinion as to whether it was worth while to begin the work.

This cautious, practical procedure would be followed in attacking any of the problems which demand attention. The backers of the Gray Iron institute are practical, experienced, successful foundry executives. They have no desire to spend money on any program that does not seem likely, after careful consideration, to produce tangible and practical results which will be worth the cost.

Propose Remedies

Keeping this in mind, let us examine what activities they recommend for the Gray Iron institute.

The three basic weaknesses outlined above were:

1. Decrease in Demand for Gray Iron Castings.
2. Overcapacity.
3. Prevalence of Unsound and Unscientific Business Methods.

Taking these up in order, the remedies proposed at Pittsburgh were as follows:

1. The collection and distribution of existing information about the production of high quality castings.
2. Publicity to counteract propaganda now being circulated against gray iron castings.
3. Research work to improve the quality, decrease the cost, and find new uses and markets for gray iron castings.
4. The establishment and maintenance of standards of quality.
5. The study of excess capacity for the purpose of finding some practicable means of reducing excess capacity, such as:
   a. Discouraging the building of additional foundry capacity either by new investors or by manufacturers.
   b. Encouraging manufacturers having foundry departments to devote this space to other uses and buy their castings from jobbing foundries.
   c. Encouraging the consolidation or merging of foundry companies.
   d. Encouraging the liquidation of unprofitable foundries and the diversion of their facilities to other uses.
   e. The development of specialties which would take up some of the excess capacity of foundries now doing only a jobbing business.
   f. Distribution of statistics on trade conditions. If the foundries knew that there was only sufficient demand in their district to fill 50 per cent of the available foundry capacity, they might not be so eager to reach an unattainable 80 or 90 per cent, and might settle down to

reducing overhead and trying to make a profit by efficient operation at 50 or 60 per cent.

6. The collection and distribution of information leading to the adoption by the foundries of
   a. Up-to-date merchandising methods.
   b. More accurate and uniform cost accounting methods.
   c. Uniform trade customs and code of business ethics.

7. The promotion of the formation of local groups or associations of foundries for the advancement of common local interests. The successful results obtained by a rapidly increasing number of local groups of foundries, along lines of uniform cost or uniform trade customs proves that the spread of this local group idea will be an effective means of improving local conditions. An important by-product of local group activities is the growth of a much more friendly and co-operative spirit among nearby competing foundries.

The preceding is a fairly complete summary of the program proposed for the new Gray Iron institute. As the work progresses, other worthwhile opportunities for service will develop, and in general, the scope of its activities will include anything which might tend to advance the interests of the gray iron foundry industry.

Can we expect to get real practical results from such a national program? Emphatically, we can. Foundrymen in general have been slow to awake to a realization of the value of getting together, of co-operative group activity for the benefit of the local district, or the industry as a whole. The benefits which have been obtained by association activities in other industries are a matter of record, and cannot be questioned by any one who will investigate.

A list of 25 or more successful national associations proves this. The members of these associations are hard-headed business men, just like the foundrymen. In fact it is probable that an impartial and competent judge would decide that they were better business men than the foundrymen; and they have probably made more money than gray iron foundrymen. Can we not profit by their example?

But some of our well known hard-boiled pessimists will say, "That may be all right for other industries, but it can't be done in the foundry business. Foundrymen are a hopeless lot, and it is impossible to get them to work together."

Well, it can be done; it has been done, and it is being done in certain localities. The results secured by associations such as the Ohio State Foundrymen's association, and by local groups in Pittsburgh, Philadelphia, Chicago, Newark and many other places, prove that foundrymen can work together just as harmoniously and effectively as any other business men, provided that the organization is managed properly. If you have had little success in your own district, and are inclined to be pessimistic, just visit the leaders of some of these successful groups or associations and you will be thoroughly convinced that group activities can get results, among gray iron foundrymen. Then go home and start something in your own locality. One of the objects of the institute will be to acquaint foundrymen in general with the practical results secured by local groups of foundries already in existence, some of whom have been active for over 20 years!

One more phase of the situation should be clearly understood, and that is the relation of the Gray Iron institute to other existing national foundry organizations. These are: The American Foundrymen's and the National Founders associations.

Some will say, "Why do we need another association? Cannot the A. F. A. or the N. F. A. do this work for us?"

There are several reasons why these organizations cannot carry out the program outlined for the Gray Iron institute. The fundamental reason is that both these organizations include gray iron, steel, malleable, and nonferrous foundries, and they must serve all branches impartially.

The A. F. A. has only a moderate income, based on nominal dues of $12 per year. They are fulfilling a most important function in the industry and the work they have done and can do will be of great value to the gray iron branch. Their co-operation on the general phases of technical research gladly will be extended and the value of this work will be enhanced by having an organized body of gray iron foundrymen to speak for the industry.

The N. F. A. is under the same obligation to serve impartially all four branches of the industry. Their primary function has been to deal with questions of personnel, wages, working conditions, etc. They recently have increased the scope of their activities and their assistance is valuable and it is hoped that it will be forthcoming in increasing measure. But that organization could not possibly undertake to carry out the program outlined for the Gray Iron institute.

Realizing this situation, the steel foundries some time ago formed their own national trade association, the Steel Founders society. The malleable foundries formed the Malleable Iron Research institute. These organizations each serve their own branch of the foundry industry exclusively. They have attained results.

It is high time that the gray iron foundries had a national organization devoted exclusively to the interests of the gray-iron foundry industry. They must organize as a matter of self-preservation and enlightened self-interest. No one else can do it for us. We must do it ourselves.

However, this does not mean that our activities will conflict with those of any other organization. For any work which they have done, or will do in the future, we wish to give them full credit. We intend to co-operate with them fully, and seek the co-operation and assistance which already has been offered by both the A. F. A. and the N. F. A. at the Pittsburgh meeting.

Report Equipment Sales

The index of gross orders for foundry equipment in February was 123.6 as compared with 129.7 in January, according to a report of the Foundry Equipment Manufacturers association. The index of shipments was 110.6 in February against 116.4 in January. Unfilled orders increased from 110.7 in January to 132.9 in February. The base is the average monthly shipment for the years 1922-23-24. Comparisons of monthly orders follow:

	1924	1925	1926	1927	1928
Jan.	141.8	104.2	168.2	180.4	129.7
Feb.	121.0	108.8	154.9	198.0	123.6
March	121.9	159.3	157.3	131.1	.....
April	146.8	124.3	113.2	130.0	.....
May	108.4	113.3	128.5	134.8	.....
June	96.4	110.5	133.5	138.4	.....
July	62.8	117.0	127.3	89.9	.....
Aug.	77.5	190.0	141.2	106.4	.....
Sept.	66.0	84.2	114.0	80.4	.....
Oct.	85.5	149.5	140.5	98.0	.....
Nov.	91.4	180.3	133.4	95.8	.....
Dec.	137.8	140.1	181.0	106.8	.....

Sells Sand Machines

The Royer Foundry & Machine Co., Wilkes-Barre, Pa., has sold sand separators and blenders to the American Radiator Co., Kansas City, Mo.; Delaware, Lackawanna & Western Railroad Co., Scranton, Pa.; Detroit Lubricator Co., Detroit; John Douglas Co., Cincinnati; Enterprise Foundry Co., Los Angeles; Fairbanks, Morse & Co., Beloit, Wis.; Green Foundry Co., St. Louis; King Co., Sheffield, Ala.; Koehring Co., Milwaukee; Marietta Hollow Ware & Enameling Co., Marietta, Pa.; National Bearing Metals Corp., Jersey City, N. J.; Sawbrook Steel Casting Co., Cincinnati, O., and Charles Walmsley Co. of Canada, Ltd., Longueuil, Que.

Circular Annealing Furnace PRODUCES *Good* Results

By Jerome Strauss

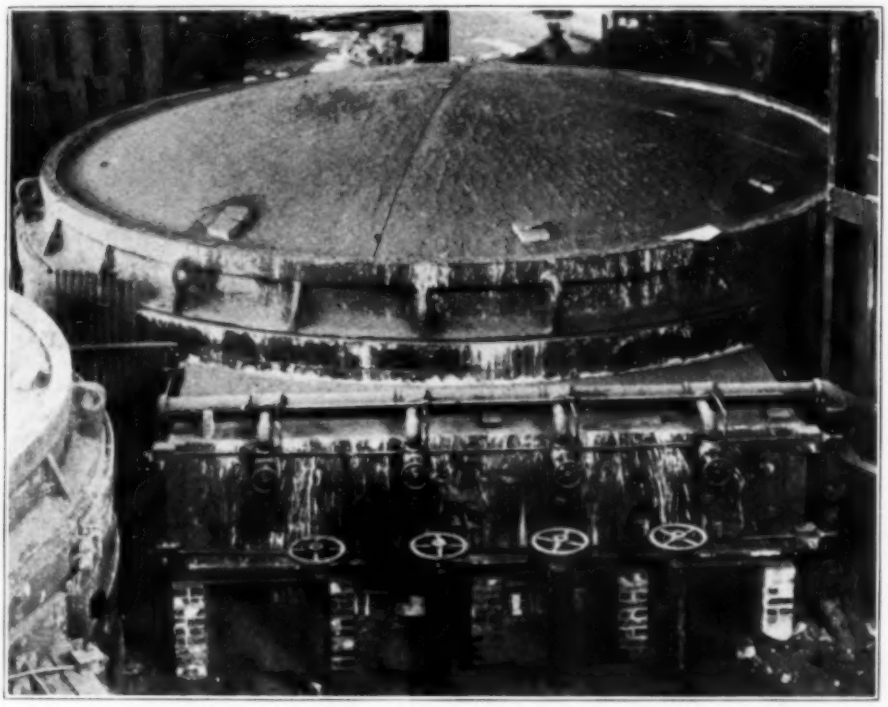


Fig. 1—How the Completed Furnace Appears from the Burner Side. The Hand Wheels in the Foreground Control the Draft Dampers

The furnace described in this article is the second of its type that has been designed and erected in the steel foundry department, United States Naval Gun factory, navy yard, Washington. The author is material engineer, metallurgical and testing division, Naval Gun factory.

RESEARCH directed toward a predetermined objective yields oftentimes, as by-products of the investigation, principles, processes or other findings of much greater importance than that objective. Likewise, in industrial operations, ends sought and attained frequently are subordinated to the incidental accomplishments.

From this, as well as other angles, the furnace construction described in this article is of interest, for though designed originally for the sole purpose of processing a specific group of castings, results of a general character have been such as to establish a policy for all future construction of similar equipment.

The furnace described is the second one of its type and size and both are functioning beyond original expectations. The circular form of the first unit was dictated by the castings to be annealed (a group of hollow cylindrical castings of complex detail from 14 to 22 feet in diameter) while the building of the second was governed not so much by these same considerations as by limitations of floor space and the excellent results obtained in the operation of the first furnace. However, as will be pointed out later, even in the absence of the restrictions, the performance records of the first unit would have resulted in the same decision.

Among other noteworthy features is the one-piece roof, 26 feet in diameter overall and weighing about 25 tons. The outlets for the products of combustion are arranged to permit close temperature control by distributing the heat at the will of the operator. The number of ducts in each quadrant is different at the front and at

Fig. 2—Constructing the Floor of the Furnace. The Channels in the Floor Are Connected Sectionally to Four Main Flues. Fig. 3—The Main Flues from the Floor Channels Open into the Stack Flue

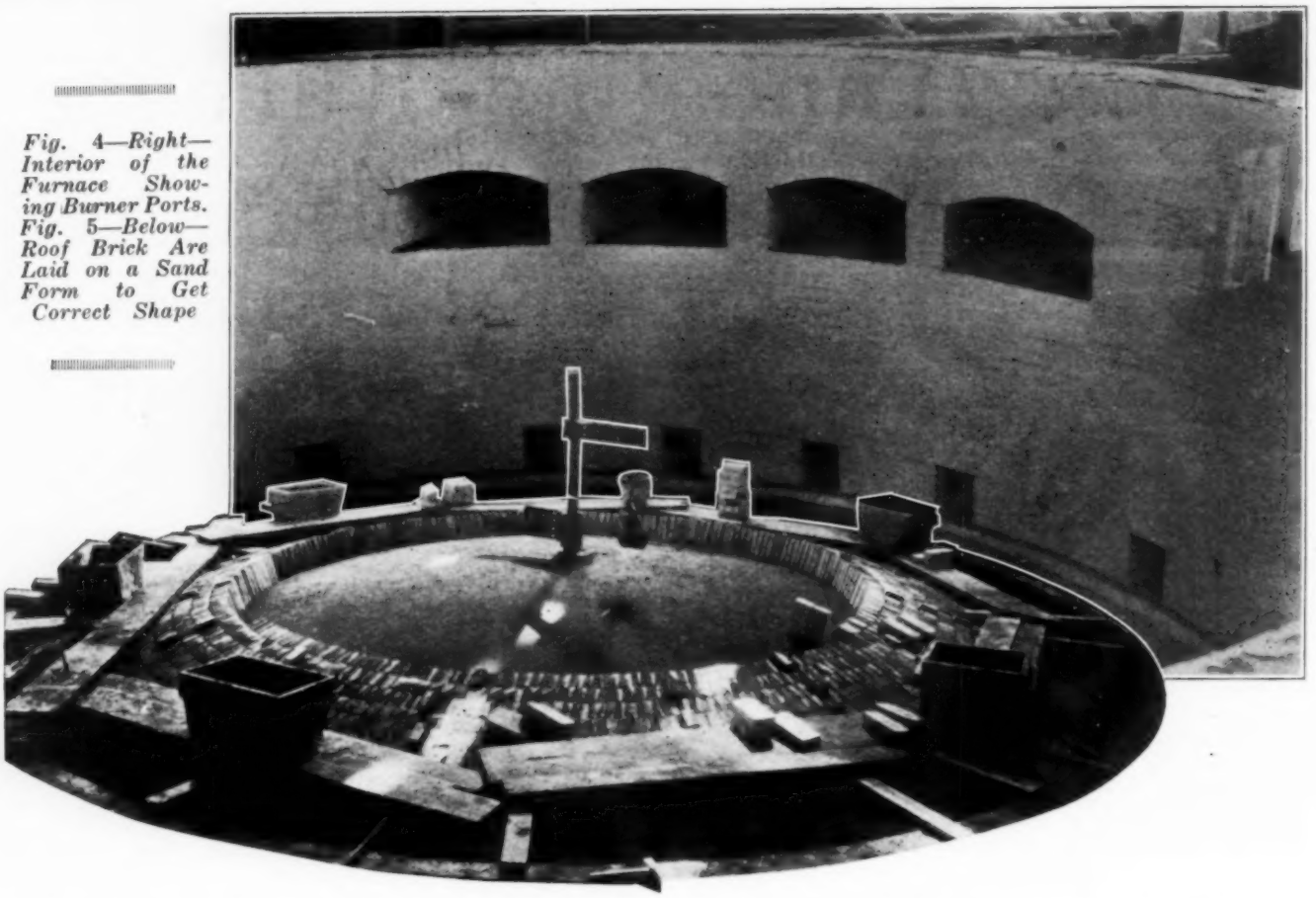


Fig. 4—Right—Interior of the Furnace Showing Burner Ports. Fig. 5—Below—Roof Brick Are Laid on a Sand Form to Get Correct Shape

the back of the furnace and each quadrant is under individual damper control. Four oil burners are provided, although three will produce and maintain a temperature of 1600-1650 degrees Fahr., thus permitting burner replacement or repair without furnace shutdown or delay. Liberal use of insulating brick has resulted in both fuel saving and simplicity of temperature control.

The concrete slab supporting the furnace rests upon a group of long wooden piles, for the Potomac river is less than ¼-mile from the furnace and the foundry floor is only a few feet above mean high water. This condition made it impossible to set the furnace more deeply into the ground than is shown in Fig. 1. With a more favorable location, the entire furnace could have been built into the ground (up to the level of the bottom of the roof) with consequent more effective heat insulation throughout the furnace.

A cross section of the structure, through the center of the furnace chamber, and through port, burner opening and damper control appears in Fig. 6. This drawing, along with the Figs. 1 to 5 inclusive, show the details of the design.

With the exception of the furnace floor, which is built of 12-inch fire-brick slabs to secure the necessary

(*Concluded on Page* 303)

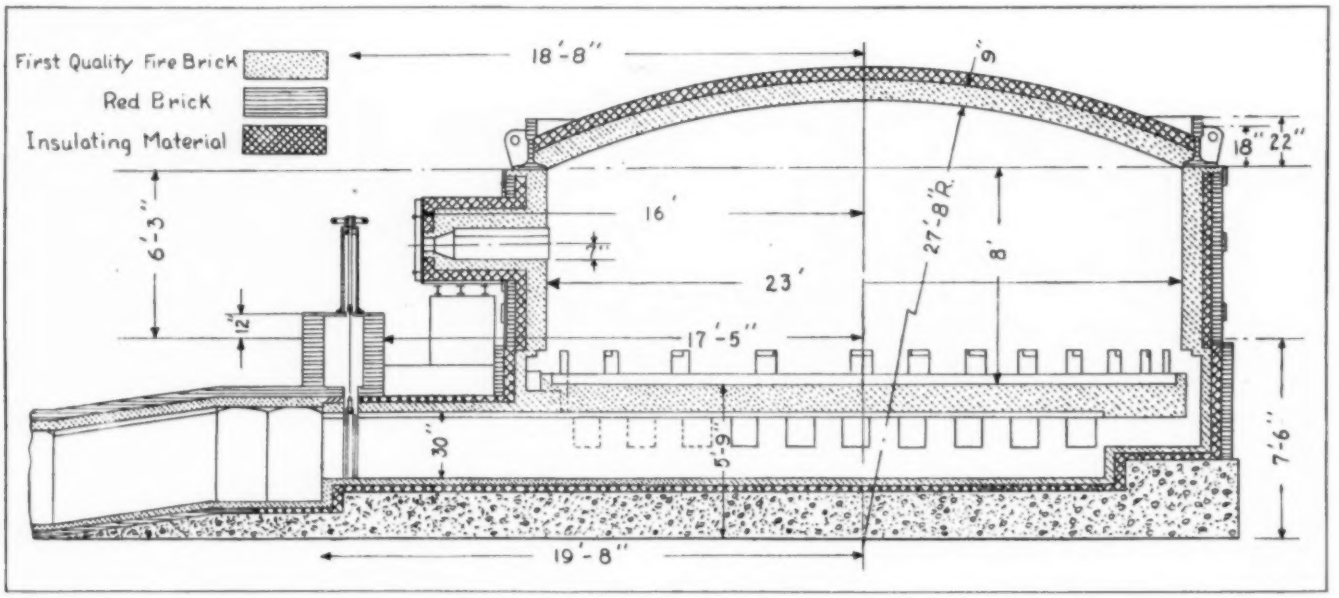


Fig. 6—Cross-sectional Elevation of the Furnace at the Center of the Chamber, Through Port, Burner Opening and Damper Control

Removing the Hazards from

Piece Price Quoting

Errors Which Occur in Making Weight Estimates May Be Classified and Analyzed to the Point Where Attention to Detail Will Eliminate Them

By O. C. Gilbert
(Consulting Engineer, Chicago)

IN A previous article, appearing in THE FOUNDRY for April 1, some of the dangers which arise in establishing a piece-price basis of selling steel castings were enumerated. Of course the greatest risk is in a cumulative error as was explained. The errors from which a piece price quoting system must be guarded may be classed as *primary* and *secondary* errors.

A primary error is one affecting only one estimate although it may be of such a nature that its repetition in other estimates is likely to occur. A secondary error is one likely to occur in any estimate made under conditions that permit it to happen. Secondary errors are due to the presence of inaccurate methods of control in the foundry or in the estimating department, or through keeping records in such a manner that they cannot fulfill the end for which the record system was devised.

Secondary errors cause far greater losses to the foundry and are the hardest to detect and eliminate as for the most part they are the result of conditions beyond the ability of the personnel, directly involved, to isolate and eradicate. They are partly the result of attempts to make truce with necessity and in time are likely to affect a sufficient percentage of the file weights to necessitate the abandonment of any attempt at accuracy except in new designs.

A complete list of the sources of secondary errors are beyond the scope of these articles but a few will be given and the system of weight estimating outlined in a subsequent article has taken into account the elimination of all of them.

A common source of secondary error is the operation of a weight

Part II

estimating department without provision for the checking of a certain percentage of the work turned out, by an outside source. This is a certain invitation to secondary error trouble. The qualifications required in an accurate estimator are not easy to secure and it is certain that they will not always be found in both the estimators required. It is imperative that when this condition arises it become known without delay.

Another source is division of responsibility for weight estimates. Such division may not safely be made. To delegate a part of the work to the drafting room by having the draftsman turn in a weight slip for the weight changes involved in a change of design he has made in a tracing, is a dangerous procedure. This type of weight estimate is exceptionally difficult to make, even for a specialist doing nothing else.

Expensive Time Saving

Making weight estimates from unchecked drawings to save time and to get the estimate in the hands of the sales department at the earliest time possible, is another source of secondary errors. It is a serious source and the number of errors that get through when this is attempted is surprising. In theory the drafting-room checker is expected to notify the estimating department of any changes in design made after the unchecked print is submitted to the estimating department. In practice he will depend upon memory and will not always remember.

A further source of secondary error, difficult to contend with, is a weight filing system that does not fully meet the requirements of the method, but one in which the difficulty and cost of changing the system cause it to be continued. Such a system may provide for the entry of both estimated weights and running weights, with provision for changes in issue running all the way to the end of the alphabet and yet for the piece price quoting method it might fall down through having no provision for the correction of passed issue weights when mistakes are uncovered in previous quoting weights. To enter the correction as of the last issue invalidates the card for all previous issue weights while in practice these occasionally must be used in supplying quoting weights to the sales department. The necessity for such provision in the files is unlikely to be foreseen in advance and by the time the necessity becomes obvious the task of copying the card data upon cards of a different design may be a serious project not lightly undertaken.

A change in estimating department personnel invariably introduces errors into the weight files. The only exception to this is where an outside engineering firm specializing in the work is keeping a check upon the work of the estimating department and can supply an emergency estimator who can take up the work while a new man is being broken in to fill the position.

A source of secondary error occurring with sufficient frequency to justify classing as a source of secondary error is the occasional demand upon the estimating department for a speed in estimating a casting weight that cannot be maintained with accuracy. It is an ex-

ceptional employe indeed who will not produce what is premptorily demanded over his protest, when he has the certain knowledge that errors likely to be present will not be discovered.

The cause of secondary errors responsible for more and greater losses to the foundry using the piece-price quoting method than any other single cause is the imposition of orders upon the foundry to meet estimated weights against the protest of the foundry that the estimate is not accurate. An arbitrary attitude upon such occasions on the part of the executive in the office sooner or later will bring about the general practice of bringing the pattern to weight even though 50 to 60 pounds of metal are added or deducted from a bolster or side frame by the foundry to meet the weight demanded. When this practice has once been forced upon the foundry, all weight errors within this amount are likely to pass through the foundry without comment and the estimating department is deprived of a check that otherwise might disclose errors.

Dodging Pattern Trouble

A condition with which it is difficult to contend unless special provision for such emergencies is adopted and enforced is illustrated by the case where a mistake is discovered by the estimating department in a previous weight estimate involving a pattern having many different issues and where the correction of the file weights would involve the alteration of all of these patterns to bring them up to weight. The method likely to be invoked in an instance of this sort is to bury the mistake. Even though the effect of this upon the morale of the estimating department did not justify the insistence upon file accuracy, the cumulative effect of such mistake burying over a period of years would in time build up such a mistrust of the integrity of the files that the whole structure would be in question.

A source of secondary error that becomes of increasing importance the longer the foundry has been operating upon the piece-price quoting system is the cumulative effect of file errors where the question arises whether to make a new estimate or to hang the weight estimate upon the pattern file weight for the issue coming nearest to the new design. Where a system of checks, such as the one to be outlined in a subsequent article, is not in use, the tendency wherever possible is to hang all pattern revision weights upon the previous issue weight for that pattern as by so doing it does not become necessary to change the patterns where mistakes are uncovered in the old estimates. There is no justification for such procedure.

Primary errors next may be classified as those errors involving only one estimate. They are divided into two main classes:

Estimating errors due to the incorrect analysis of the problem.
Estimating procedure errors.

Estimating errors due to incorrect analysis of the problem, constituting the first main division may be subdivided and analyzed as follows:

1—The use of the wrong base for a difference estimate.

2—The use of an unchecked drawing differing from the checked drawing sent to the foundry.

3—The use of a checked drawing that has subsequently been altered in the drafting room without change in the issue number or letter, without the estimating department being notified of the changes.

4—The use of a drawing containing errors in dimensions. This is not a matter for which the estimating department can be held responsible, but frequently such errors can be stopped there.

5—The use of drawings in which large areas are so dimensioned that taper may be interpreted in two ways, having differing weights. This also is a matter not properly chargeable to the estimating department, but one which should be corrected there.

6—Where a half or quarter of a symmetrical design is shown on the drawing used for the weight estimate, the use of the weight of this fractional part as the total weight sometimes occurs.

7—Mistakes in the interpretation of scale drawings as to the scale represented sometimes are made.

8—The use of blueprints for estimating purposes without making a layout when the scale is too much reduced to permit accurate measurement of dimensions is another source of errors.

9—The use of blueprints or photostat prints for weight estimates without first checking every dimension for print accuracy sometimes leads to trouble.

10—Estimating a fractional part of an apparently symmetrical drawing without checking to determine to a certainty that the design is completely symmetrical is another danger.

11—Where difference estimates are made of design changes such for instance as a side frame of the American Railway association type changed to a Barber type or a bolster with the center plate design changed as to radius and height above rail, the incorrect analysis of the areas affected may cause an incorrect weight estimate. This is a type of estimate likely to be left to the draftsman making the drawing changes as it looks simple whereas it is difficult to estimate and still harder to check.

12—The estimate of cast segments of a large radius spherical shell or cylindrical shell by using the volume difference between the outer and inner spheres or cylinders as the basis of the estimate will lead to errors as the formulas for spherical volumes in the handbooks are approximate and the percentage error may be a considerable part of the weight of the thin shell being estimated.

13—The avoidance of pyramidal and conical frustrum formulas and the use of the average area times the vertical height as a means of calculating the volume, when the slant of the side is considerable, will lead to errors.

Estimating procedure errors, the second main division of primary mistakes, may be further divided and analyzed as follows:

1—Decimal errors. Addition errors. Multiplication errors.

Laws Governing the Safe Use of Price Quoting

The hazards of the system should be recognized by the executives. A system free from secondary error liability as herein outlined should be installed.

A weight estimating department independent of the drafting room, clerical department and sales department should be maintained.

The weight estimates should be made according to a standardized procedure.

This procedure should prohibit errors classed herein as primary errors.

The integrity of the weight files must be maintained against compromise in face of all the incentives to compromise as cited in this article.

An outside check upon the work of the estimating department must be maintained.

2—Calculating machine errors.

3—Areas and volumes occurring more than once not so multiplied.

4—In large castings of uniform thickness, the total of the areas of like thickness may become confused with the volume extensions and this total used as a volume extension instead of being multiplied by the thickness in extending the volume.

5—Failure to multiply the total of the volume extensions by the factor 0.29 thereby making use of the volume in cubic inches as if that were the weight in pounds.

6—Where the weight on half of a symmetrical casting is estimated it is sometimes neglected to multiply this by two.

7—Sometimes the weight of a non-symmetrical casting is multiplied by two in error due to the fact that most estimates are of symmetrical castings and the extension total is therefore multiplied by two.

8—The failure to multiply the product of the base and the vertical height of a triangular area by one-half in extending the area. This is an error frequently encountered by the checker of a weight estimate and one easily passed by him.

9—The use of the wrong scale in scaling prints.

10—There may be an error in the layout used for the weight estimate.

11—An improperly set planimeter used to measure irregular areas may be a source of error.

12—Incorrect interpretation of the drawing is another source.

13—The duplication of numbers used to identify areas on a layout and the consequent omission of the area in making the take-off. This is a type of error likely to be overlooked by the checker.

Errors in weight estimates are likely to be passed by the checker. The error more likely to be overlooked by a checker than any other on the list given is the failure to multiply a volume by two when it occurs twice. Next in frequency of occurrence is a mistake in an extension total. Two forms of extension total errors are likely to be overlooked by the checker. These are decimal error and an incorrectly totaled inner extension. The latter is a liability if it happens to occur in an estimate on which the checker is interrupted while checking the last item of the incorrectly totaled inner column. The check mark upon this item easily may be supposed to be a check upon the total just beneath upon resuming the checking and he may use this total as a checked item.

Another error easy for the checker to overlook is one in which the estimator has failed to carry an extension to the last column. This is especially dangerous if it occur as the first item on a page or is a single line extension coming between extensions of many lines each.

In the case of metric drawings for export quotations the greatest caution must be exercised in determining the decimal point when the total volume in cubic millimeters is reduced to pounds or to metric tons, as a casting of large size reduced to cubic millimeters involves a figure of imposing extent.

The succeeding articles will deal with the equipment, personal and procedure recommended in installing a piece-price system.

Circular Furnace Gives Good Results

(*Concluded from Page* 300)

strength across the flues, the furnace chamber lining consists of 9 inches of fireclay brick covered by 4½ inches of insulating brick. In addition, the cylindrical furnace wall further is increased in thickness by 4½ inches of common clay brick. This is supported in turn by several pieces of steel plate laid end to end and held in position by three steel hoops with ends clamped by steel bolts. In Fig. 6, 2½ inches of insulation is shown below the firebrick at the base of the flues. However, due to questioning the strength of this brick at working temperatures, this was replaced during construction, by common red brick.

The burners are supplied with fuel oil at 30 pounds per square inch pressure and primary air at 2 pounds per square inch pressure. As previously noted, the furnace is equipped with four burners, but the highest commonly used annealing temperatures can be maintained with three without the necessity of consuming their maximum capacity of 25 gallons per hour, each. The burner ports are shown in Fig. 4.

An excellent idea of the flue construction may be had from Fig. 2. Twenty-eight small flues or ducts lead from the inner circumference of the furnace chamber, at the floor level, to four main flues that in turn merge into a single passageway connecting with a 75-foot stack. One small duct is located at either end of a diameter drawn perpendicular to the direction of the four main flues. In the half circle embracing the burner openings ten additional ducts begin, while in the other half circle are sixteen others equally spaced. Each of the four main flues carries off the products of combustion entering the ducts in one-quarter of the furnace circumference. Then, as noted, all four combine to form one huge flue leading to the stack. Part of this construction is shown in Fig. 3. Just back of the point shown are the dampers, by which the passage of burned gas through each flue, and hence the heat applied in one zone of the furnace is controlled.

As may be surmised, the building of the one-piece roof presented a number of interesting problems. The retaining ring for the brick work shown in Fig. 1 is a single steel casting made without a complete pattern. The mold was built into the foundry floor and the inner surface swept in green sand, after the fashion of loam-mold practice; this green sand was then air dried. One section of pattern, representing one-eighth of the outer surface exclusive of the lifting lug, then sufficed for constructing the balance of the mold. The portions to form the lifting lugs were prepared last, using core sand in accordance with usual steel foundry methods. The section was desired as light as possible but stress considerations made reinforcing necessary; hence the heavy upper section which served as both strengthening member and shrinkhead. The casting made, it was carefully set around a mound of sand modeled to true form with a sweep, and with this inexpensive and simple equipment the layers of roof brick were set in position as may be seen in Fig. 5.

Improvements secured from this construction, the initiation and design of which rested practically entirely with the foundry supervisory staff, may be summarized briefly:

(a) Elimination of cold corners and cold floor, for the temperature of the latter lags but little behind the temperature of the furnace chamber.
(b) Economy of floor space.
(c) Single lift for roof removal.
(d) Fuel saving due to insulation of walls, and to under-floor flues.
(e) Uniform temperature rise and uniform cooling readily secured.

These results have been observed over a period of time on both furnaces to a degree somewhat beyond expectations. Temperature variation around the entire chamber, as recorded by 8 equally spaced thermocouples, is commonly less than 20 degrees Fahr.; the variation may, if required, be reduced to half this amount. During the period of rising temperature, differences of temperature are dependent, of course, upon the rate of heating.

Bill Touches on Some Problems in Molding-III

By Pat Dwyer

"WHILE glancing casually through the paper tonight," said Bill, "I came across a little item to the effect that the arbiters of fashion, whoever they are, have decided to crown every full grown male with a brown derby this coming season."

"Well," I said, "what about it? I know one citizen, name given on request, they won't crown with a brown derby, or a black, or a blue or a green one either for that matter. Of all the monstrosities ever designed to cover a man's head I think one of these cast-iron kellys is the most atrocious and a brown one is the worst of the entire tribe. It was tried before at one time and enjoyed a certain vogue among the weak-kneed class who will wear anything ridiculous if it is considered fashionable, but it finally was laughed out of existence. The name has been a byword, a reproach, a mockery for years. I have not seen one for 25 years. The last one I saw, a hand-me-down, was worn by old what's-his-name, you remember him, the crabby old gateman on No. 3 gate. I won't say the bonnet was altogether responsible for his ultimate fate, he always was queer, most gatemen are, but he finally was carted off to the bug-house up the river. Let that be a warning to you my lad, if you have any intention of masquerading under the shade of one of these curiosities." "Who, me?" Bill replied. "I have no more intention of wearing one of these things than I have of donning a nail keg or a wash boiler. Isn't it a sad commentary on the intelligence of human beings to find how readily they adopt a new fashion in garments and then as readily drop it in favor of another a year or two later. Not only drop it but actually laugh at pictures of themselves depicted in garments that were the height of sartorial elegance a few years previously.

"The only people who really are consistent and therefore by inference the only people who really are sensible, are those whom we in our superior ignorance regard as savage, or at best only semi-civilized. They never change. A few streaks of paint and a nose ring satisfy the native of Polynesia today as they satisfied his predecessors who welcomed Captain Cook in Tahiti in 1768 and as they satisfied their ancestors to a time when the memory of man runneth not to the contrary."

"What's the use of quoting an example of that kind?" I asked him. "Would you be satisfied to go around in that condition? A shiny and irresistible target for every winged insect, including wasps and bumblebees, in the neighborhood. A fine sight you would present with a ring in your nose like a bull at a fair. Why don't you go back a step further and refer to the chaste and simple fashions of your exceedingly remote ancestors who wore nothing artificial and who swung by their long, curling tails from the teetering tops of tropical trees in the depths of the jungle. According to your argument these nimble lads constitute the only sensible branch of the human family. They still carry on in the same manner."

"Yes," said Bill, "they still carry on in the same manner. I know one now that is carrying on more like a monkey than a human being. 'Pon my word I've seen a hurdy-gurdy man's monkey in a tasseled cap and a red coat who showed more evidence of intelligence.

"Lissen here for a minute, that is if you are capable of concentrating for that length of time, which I doubt. I merely referred to the South sea islanders as examples of consistency. I did not advocate, even by the remotest inference the adoption of their clothing in a country with a climate like our's.

"Many years ago Mark Twain published a notable defense of Lo, the poor Indian who preferred to wear a coat of paint and dirt ¼-inch thick instead of civilized garments. Mark explained that the poor, untutored child of the forest instinctively realized the insulating value of this material. He claimed that a series of scientific tests recently concluded had proved conclusively that a layer of dirt gradually accumulated to a depth or thickness of ¼-inch had a greater heat and cold resisting value than a $50 suit of clothes." "Maybe I'm dumb" I admitted, "but still I fail to get your drift. As I see it, at first you were highly in favor of masquerading as a Hot-

THE WELCOMING COMMITTEE TRIES THE LODGE GRIP ON A VISITOR

tentot or a cannibal chief from the Fiji islands. When I quite sensibly directed your attention to the silly figure you would cut in that primitive outfit, you craftily shifted your base. Am I correct now in assuming that you intend to cover the old frame with a daubing of slurry like a loam core? I suppose in extremely cold weather you will add an overcoat in the shape of a dash of blacking applied with a spray gun."

"I'd like to spray that thick knob of your's" said Bill, "with a gallon or maybe a gallon and a half of good, strong sulphuric acid or any other potent pickling fluid that would remove sufficient scale to allow an idea to penetrate. When I instanced the South sea islander and our own Indian I merely wanted to direct your attention to the fact that primitive people are consistent in their habits. They adopt a style of clothing suitable to the climate and once adopted they stick to it world without end. Amen. Arbiters of fashion mean nothing in their young lives. All the king's horses and all the king's men could not force them to adopt a new style. We are the easy marks. Some restless, neurotic individual with a craze for the spot light, but without either the brains or ability to attract attention in a legitimate manner, stirs up a certain amount of attention by wearing a garment or garments that differ from the prevailing mode. Like a flock of silly sheep we all fall into line. Instead of ridiculing the inventor, we hasten to deck ourselves out in the same style and then sneer in a highly superior manner at any unfortunate who lags behind the procession.

"I heard of an instance recently where a lady's ambition to own a fur coat landed her in an embarrassing position."

"That's rather odd," I admitted. "According to all the evidence so far collected a lady's ambition to own a fur coat usually places her husband in an embarrassing position. Did she get the coat?"

"Well," said Bill, "yes and no. She did and she didn't."

"Nothing could be clearer than that," I agreed handsomely. "Yes and no. She did and she didn't. What's the answer?"

"My dear lad," said Bill, "I am pleased at this evidence of impatience. It shows that the old mind has not completely atrophied; that a dim glimmer of intelligence still flickers inside the ivory dome. Maybe if I repeat the story three or four times you will get the general import."

"Once will be enough" I told him. "Just once and for heaven's sake cut it short."

"Short is the word," Bill grinned. "You know me, kid. A man of few words. This here dame I was telling you about set her mind on the possession of a fur coat and then pestered the life out of her husband to buy it. He told her flatly he could not afford it, but being a married man yourself you can realize the value of that statement in stopping the everlasting argument. Finally, after exhausting the entire bag of tricks usually designed to bring one of these stubborn brutes to his senses and a realization of his duty, she hit on a brilliant scheme and pretended to be reconciled to her fate.

PILGRIM IN SIGHT OF THE PROMISED LAND

"She borrowed $300 from a confiding friend on the plea that she only wanted it for a short time to tide over an emergency. She would return it in a month or two. Mind you she had no more idea than one of the pigeons in the park of where she was going to get the coin, but she did not let a litt'e detail like that trouble her. Sufficient to the day and all that kind of thing. The pigeons do not worry about tomorrow. Why should she? Such childlike faith is beautiful. Shows you what a dear little unsophisticated lady she was. Just a weak, innocent victim of our cruel, man-made customs, using the instinctive weapons with which kindly nature has endowed the weak and downtrodden little members of the weaker sex.

"She bought the coat and then took it to a hock shop where she shoved it up the spout for $50 and told the pawn broker that her husband would redeem it in a few days. She placed the pawn ticket in her handbag and then rounded out the day by attending a matinee where she wept luxuriously over the tribulations of a beautiful heroine, expensively gowned, who narrowly escaped a fate worse than death in three reels, to be finally rescued by C. Kane Charlevoix the handsome and only son of a multimillionaire oil man from one of the great open spaces. That night—to continue the similitude—she told her husband she had found the ticket and wouldn't it be just darling if he called at the pawn shop to see what kind of an article it was. Perhaps it was something really worth while and he could get it for the payment of some ridiculously small sum! She figured that he would snap at the chance of getting a $300 coat for $50. He did not kindle to the idea. Told her that the article probably was a broken winded accordian or an early model brass watch. However, he finally offered to investigate. You can imagine the suspense she was in all day. He arrived home at night and handed her a second hand umbrella that probably retailed in its palmiest days for $2. He remarked carelessly that he had warned her the thing probably was no good.

"There she was, tied up as tightly and just about as happy as a lioness caught in a net. She could not admit her duplicity. A few days later she visited her husbands office. His stenographer came in from lunch and hung up her coat—by all the everlasting gods and godesses of high Olympus—*her* coat, *THE* coat, as calmly and nonchalantly as if she had owned it all her life. Good night! Hey?"

"Do you mean to say?" I inquired indignantly "that you are going to leave me hanging in the air? What's the remainder of the story?"

"If you have any imagination," Bill replied carelessly, "You can finish it for yourself. However, that reminds me I left another story about the methods for molding a tank or trough in open sand unfinished the last time I was here.

"Assuming that the coke bed has been placed in the bottom of the hole with a suitable pipe erected

at one end to form an outlet for the steam and gas, the pattern is lowered into place and adjusted approximately level on four blocks of any kind, bricks for preference. A level is applied to the top of the pattern and wood wedges are inserted under any or all of three lower corners until the level on the top indicates that the four upper edges are on a true and level plane. Sand then is rammed under and around the lower part of the pattern up to a height of several inches.

"Sand on the inside of the pattern must be reinforced with rods to a greater or less extent depending on the length and width, but principally on the depth. Up to 18 inches, one course of rods near the top is sufficient on the outside. An additional course of rods laid horizontally at every 6-inch level is needed for vertical walls over that height. These rods are not required to reinforce the walls against the pressure of the metal. They prevent the walls from caving under the weight of the molder kneeling or standing in the vicinity after the pattern has been removed. The weight primarily of course is taken by boards laid flat close to the edges of the mold.

"Ordinarily, as stated elsewhere the outside of the mold is rammed first. The pattern is braced on the inside in a suitable manner to prevent distortion during this operation. The wedges under the corners are removed after the first sand has been rammed under the pattern.

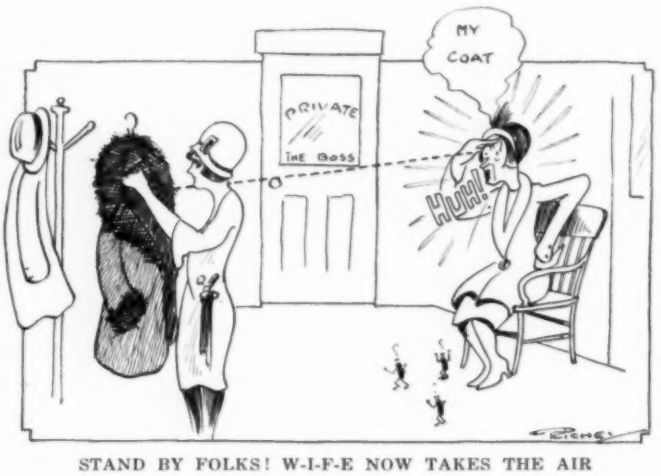
"Bottom gating has the advantage of introducing the first metal gently, but it presents the disadvantage of probably cutting the sand in the vicinity on account of the great amount of metal entering at great speed and under considerable pressure. A constant stream of iron entering at the bottom and pushing iron ahead of it higher and higher has a tendency to strain the walls of the mold at the bottom and produce a casting beyond the anticipated thickness. This contingency does not arise in making bulky castings or in dry sand molds, but it is one that must be taken into consideration in comparatively thin, deep castings made in green sand molds. Where these castings are poured from the top the iron has a chance to solidify as it rises and thus resist the constantly increasing pressure as the mold is filled to the desired level at or near the top.

"Where bottom gates are used in conjunction with upper runners they may be connected to the same pouring basin in such a manner that iron for the greater part of the casting is poured in at the top of the mold. The lower gates vary in size depending on the amount of iron destined to be poured through them. They are made thinner than the space between the inner and outer wall of the mold and must be set accurately in line to prevent the metal from striking the sand in the mold.

"These gates are formed according to three methods with the choice to a considerable extent, depending on local conditions. For example, the molder might favor the use of a gate core, but if no core is available on a hurry-up job he will employ one of the other methods. In the first method deep narrow gates are cut in the sand with a lifter at or near the bottom of the pattern close to the edges at one end. These gates extend from the wall of the pattern to two upright gate sticks, rectangular in cross section and approximately the same height as the pattern. A brick or a slab core is placed over each gate and ramming of the remainder of the sand continues as usual.

"In the second method two set gates are located horizontally at the desired points and sand is rammed around them. These set gates formed of wood and finished to the proper dimensions produce a more desirable opening than gates cut with a lifter. However, they must be watched closely during the ramming operation. They are easily displaced and unless rectified will not throw the stream of iron properly into the mold. These gates also are removed immediately after they have served their purpose and the opening is covered with any convenient material, thin steel plate, a brick or a piece of slab core. At a pinch a tin can be flattened out or short pieces of steel barrel hoops laid side by side will serve.

"The third method and the most desirable, employs a runner core with a slot the size of the desired gate through the center. This style of runner is employed freely in many foundries and a stock of these cores in various sizes usually is kept on hand. One of these cores is adjusted in place at each corner of one end of the pattern. The upright gate stick is set to prevent any sand from entering the outer end while the inner end is pressed closely against the pattern.



STAND BY FOLKS! W-I-F-E NOW TAKES THE AIR

"Sand rammed around the core holds it firmly in place, but usually it is necessary to reinforce the sand between the upright runner and the end of the mold to prevent the pressure of iron from pushing the end wall of the mold forward and thus shut off the space originally destined for the iron. Various methods are employed to reinforce the sand. A succession of iron bushings 6 to 8 inches in diameter is built up around each runner stick as the ramming of the mold progresses. This method is widely practiced on jobs where facing sand is rammed around the runner stick. It conserves the facing in addition to acting as a reinforcement.

"Six inches is taken as the average thickness of sand rammed by a molder. Exceptional men ram heavier courses, but many men rarely ram more than 4 or 5 inches to a course. The exact thickness sometimes represents all that a man is capable of doing and sometimes it merely represents faulty instruction received during the apprenticeship period. Men largely are creatures of habit and a great deal of faulty technique may be traced to inadequate instruction or even lack of instruction in the early formative years.

"This same lack of instruction also, is responsible for the habit of many molders to fully pein-ram the entire surface of every course of sand irrespective of its position in the mold. With the exception of the sand in the cope and the sand in the immediate vicinity of the pattern, all the remaining sand in the mold usually may be rammed quite satisfactorily with the butt of the rammer. With the particular pattern under discussion, a plain rectangular trough or tank with straight vertical walls, molded in a pit on the floor, the pein end of the rammer is little needed.

The FOUNDRY Family Photograph Album

Upper Left

A. E. HAGEBOECK
Frank Foundries Corp., Moline, Ill.

Lower Left

A. A. LAUER
Bohn Aluminum & Brass Co., Detroit

Upper Right

J. R. McWANE
McWane Cast Iron Pipe Co., Birmingham, Ala.

Lower Right

W. J. NUGENT
Nugent Steel Castings Co., Chicago

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 712)

Latent Heat of Fusion

The amount of heat consumed to change a substance from a solid to a liquid state. It usually is expressed in calories per kilogram or in the English system of B.t.u. (British thermal units). To convert calories to B.t.u. multiply the calories by 3.968. This also is stated as calories per gram.

Gray cast iron.....10.4 cal. per kgm., 0.0104 cal. per gm., 41.3 B.t.u.
White cast iron.....15.0 cal. per kgm., 0.015 cal. per gm., 59.5 B.t.u.

Specific Heat (*Coefficient of Thermal Capacity*)

The calories of heat required to raise a kilogram of substance 1 degree Cent. (B.t.u.= Cal. x 3.968).

Calories per gram=Calories divided by 1000.
Pure iron .....12.2 cal. per kgm., 0.0122 cal. per gm., 48.4 B.t.u.
Gray cast iron.....10.1 cal. per kgm., 0.0101 cal. per. gm., 40.1 B.t.u.
White cast iron.... 8.9 cal. per kgm., 0.0089 cal. per gm., 35.3 B.t.u.
This is a *different* "specific heat" than the term used in calorimetry.

Linear Coefficient of Thermal Expansion

The expansion per unit length for a change of 1 degree in temperature (expressed either per degree Cent. or degree Fahr.).

Pure iron at 0 degrees Cent.....0.000011 } inches per inch per degree Cent.
Pure iron at 785 degrees Cent....0.000017 }
Steel .....0.000005926 } inches per inch per degree Fahr.
Gray iron .....0.000006466 }

The terms *Expansion, Factor of Expansion, Coefficient of Expansion,* also are used.

Thermal Conductivity

The calories of heat conducted per cubic centimeter per second for a change of 1 degree Cent. in temperature. It is also called *Conduction* or *Conductivity.*

It is sometimes defined as the heat sufficient to raise a unit volume one degree or the calories of heat conducted at room temperature per cubic centimeter per degree Cent.

Pure iron—0.1587 calories per cubic centimeter per second for a change of temperature of 1 degree Cent. Under this classification considering silver as having conductivity of 100, wrought iron=11.18 calories; cast iron=11.9 calories.

Thermal Capacity

The quantity of heat required to raise the temperature of a substance from one temperature to another.

Thermo-Elastic Properties

Materials when stressed below the elastic limit absorb heat and when stressed above the elastic limit give up heat. This phenomena is called thermo-elastic properties.

Blue Heat Phenomena

That range of temperature in which a metal or alloy is peculiarly brittle. Its cause is not understood definitely.

Examples: 200-400 degrees Cent. in steels.
Not observed in cast irons.

(*Continued on Data Sheet No.* 714)

A LEXICON OF TECHNICAL TERMS

(*Continued from Data Sheet No.* 713)

It is called blue heat phenomena because of the blue color of the steel at this temperature. This is noticeable in other metals to some extent also.

Blue Shortness

Increase of brittleness when cold working is attempted at the blue heat temperature (about 300 degrees Cent.) is called blue shortness. It is due to the blue heat phenomena.

Cold Short

The property of being malleable at high temperatures and not at ordinary temperatures.

The principle causes are dissolved gases and oxides, and high phosphorus content.

Red Short (*Hot Short*)

The property of being malleable at ordinary temperatures and not at high temperatures.

Low carbon, low manganese steels are red short.
High sulphur steels are red short.
Dissolved acids in steels produce red shortness.

Contraction

The property to reduce its volume under changes of temperature. (Considered also as negative expansion.) This is often confused with shrinkage.

Expansion

The property to increase its volume under changes in temperature (inversely related to density). All materials have a temperature of maximum density; that is, when the temperature of the material is either raised or lowered from this temperature of maximum density there will be an expansion.

This temperature of maximum density is below ordinary atmospheric temperatures for the iron carbon series.

Polymorphic Transformation Point (*Temperature*)

That temperature at which a solid metal or alloy changes from one allotropic state to another; i, e., the temperature where iron changes from alpha to gamma iron.

Dilation (*Expansion or Distension*)

The increase or decrease of volume or dimensional changes due to temperature changes is called dilation. It is the general term signifying either or both contraction and expansion.

(*Continued on Data Sheet No.* 717)

How and Why in Brass Founding

By Charles Vickers

Uses Permanent Molds

We have been experimenting with permanent molds for casting brass billets containing copper, 58 to 60 per cent; lead, 1 to 2 per cent; tin, 0.5 to 1.5 per cent; zinc, remainder. Difficulty is experienced due to an oxide which forms on the outside of the castings. We protect our molds in the same manner as is now successfully used for cast iron, which consists in applying a wash, drying and acetylene smoking just before pouring. It is possible that although this wash and smoke is successful for cast iron, that it may not be suitable for brass. We send a sample casting and also some scrapings from the molds which will explain the difficulty better than can be done by writing. This sample is a short bushing about 2 inches in diameter, and the surface is rough and specked with dark-colored little projections.

Yellow brass is notoriously difficult to cast in permanent molds. In fact permanent or long-lived molds of such alloy are confined to regular billets and sticks and short plain shapes. Castings, such as are made in sand molds are not being now made in molds that can be used over and over again. The reason for this is that it is not easy to cast these nonferrous alloys in such molds.

There is no reason, though, as we see it why yellow alloys, and all other brass foundry alloys cannot be cast in semipermanent molds, with the latter having life enough to make it a paying proposition. The molds will have to be coated, because otherwise the zinc in the brass will penetrate some of it and alloy with the mold, so in a short time the castings will freeze to the molds and cannot be detached entire. In the present case the right idea is being followed; the thing that is wrong is the coating; which is composed largely of carbon; mixed carbon and silica. We advise a change of material for the facing, while it is well adapted for cast iron, it is far from suitable for any copper base alloy, and especially one containing a large percentage of zinc. It will be necessary to experiment with facings before the right one is discovered, but if successful the research will probably pay handsomely. We will, therefore, content ourselves with throwing out a hint, which may or may not be right. The present facing is carbonaceous. It is suitable for iron because iron and carbon have a certain affinity. Also the carbon facing is of a reducing nature. It is a mistake to assume any oxidation is present on the surface of the casting, as the dark spots are reduced white metals and they have been reduced from the volatile metal in the alloy after the alloy itself had solidified. As this is easily reasoned out we will not need to go further with it. So a change in the facing will help materially. Whether a facing inert to the metals will solve the problem can only be determined by experimentation.

Wants Pattern Metal

We will appreciate your advice for the formula of a pattern alloy having little shrinkage; one that is used to make duplicate white metal patterns. Also kindly inform us how to handle the same.

A white metal alloy having little shrinkage which is extensively used for making duplicate white metal patterns consists of tin, 50 per cent, and zinc, 50 per cent. Melt the zinc first, and if a crucible is used, as it will be red hot by the time the zinc is molten, remove it from the fire and add the tin outside. The residual heat of the crucible will melt the tin and by the time it is all dissolved the alloy will be at a satisfactory temperature for pouring. Before adding the tin dissolve in the zinc a piece of ordinary sheet aluminum, about 2 inches square for one hundred pounds of the alloy. This will add to the fluidity of the alloy. As a flux use salammoniac. Do not get the zinc to the flaring point in making this alloy, because due to the low melting points of both metals it is not necessary or advisable to superheat, in the same manner required for two metals of greatly dissimilar melting points.

Makes Bronze Gears

What is the best material for making charging gears? If there is any particular process to be used in casting the manganese bronze or the phosphor bronze will you give us an idea what it is?

A good alloy for gears is specification No. 65 U. S. N., an alloy consisting of copper 88 to 90 per cent; tin 10 to 12 per cent; phosphorus 0.10 to 0.30 per cent; other impurities 0.5 per cent maximum.

The proportions ordinarily used follow:—Copper 87 per cent; tin 11 per cent; phosphor copper 2 per cent: The latter should contain 15 per cent phosphorus. For gears of heavy cross section the addition of nickel is advisable, when the alloy becomes: copper 85.50 per cent; nickel 2 per cent; tin 10.50 per cent; phosphor copper 2 per cent. The nickel should be charged as an alloy of around 50 per cent copper and 50 per cent nickel, thereby adding the nickel in a more soluble form. The addition of nickel as above counteracts the tendency of the alloy to solidify with less density at the center.

Aluminum bronze also makes good gearing, especially an alloy of copper 86 per cent; aluminum 10 per cent; iron 4 per cent. This alloy is somewhat more difficult to cast than manganese bronze, and much more so than the phosphor bronze. It is necessary to attach heavy feeding risers to the casting and to introduce the metal into the mold in a gentle manner and in such a way that it will rise and fill the mold cavity; it never should drop or be agitated, otherwise the casting will be filled with dross in places.

Manganese bronze also may be used and is sometimes preferred. An alloy that is suitable is as follows: Melt 44 pounds of copper and 12 pounds of manganese copper together; the manganese copper should contain 30 per cent manganese. When thoroughly molten add 2 pounds of aluminum and stir, then gradually add 42 pounds, of zinc of good grade; stir thoroughly and get the metal hot while in the furnace, cool down to casting temperature with metal of the same grade. For the first heat this is procured by pouring a small thin ingot. The alloy should be at such a temperature it will require at least 3 per cent cold metal to cool it to casting temperature to avoid brittleness.

Wants Bronze Formulas

Kindly inform us of a good formula for auto bronze bushings and oblige.

The following formula will be satisfactory: Copper 90 per cent; tin 6.5 per cent; zinc 2 per cent, and lead 1.5 per cent.

Cleaning Room Progress Aids Production of Quality Castings

By Frank G. Steinebach

Part V

GRINDING has become an economical method of removing excess metal from both ferrous and nonferrous castings. Improvements which have been made in the design of machines and in methods of manufacturing abrasive wheels, have made it possible for foundrymen to operate this type of equipment in the cleaning room at a low cost. Safety features, which now are incorporated in many grinding machines, have assisted greatly in increasing the demand for grinding equipment.

The amount of excess metal which must be removed in the cleaning department of the foundry, depends on a number of variable factors encountered in foundry practice, such as the condition of the patterns, sand and metal, and the skill of the molder. Poor gating will result in excess metal after the gates and fins have been knocked off. Gates, which are molded with the pattern, instead of being cut by hand, and which are tapered to the points where they meet the castings, usually may be broken off without leaving an excessive amount of metal to be removed before the casting is ready for the shipping department. However, regardless of the care exercised in the foundry, a certain amount of excessive metal often is found on nonferrous, gray iron, malleable and especially steel castings.

As in the case of other methods employed in the cleaning room, the selection of equipment is important. Before buying, the foundryman should study the cleaning room problem carefully to determine the type of machines best adapted to his work. Care also is necessary in selecting the type of wheel to be used on the machine. It is not necessary to guess the type of wheel which should be used on a certain class of work. Experience has shown what may be expected from the various wheels on the market, and that information may be obtained from grinding wheel manufacturers.

Foundry cleaning room grinders may be grouped under three general headings, namely, bench and floor, portable, and swing frames. The bench or floor type consists of wheels mounted on a heavy stand which rests either on the floor or on a bench. Portable grinders include flexible-shaft equipment and units driven by an air motor or an electric motor. The swing frame grinder permits the surface of the wheel to be moved about on the work within a rather wide range.

Avoid Vibration

Perhaps the most important factor to be considered in choosing a grinding machine to obtain maximum grinding production, economy and safety in any grinding work is the rigidity of the machine. Vibration of the grinding wheel is expensive since it results in rapid depreciation of the machine and increases greatly the cost of repairs. Constant vibration of the wheel also tires the operator and greatly reduces his efficiency. Vibration also causes the wheels to wear out of round, thus resulting in more waste since the wheel must be trued by virtually throwing away a certain portion of good abrasive material.

Probably no other cleaning room operation offers so great a variety of equipment as grinding. Many types of floor grinders are on the market, the chief factor affecting the design being the type of drive. Belt drive grinders usually have a heavy, cast-iron base which supports the spindle, the rests, the guards and the wheels. The cast iron base is sufficiently heavy in design to eliminate troubles from vibration. Of course each stand is designed by the manufacturer to support wheels up to a certain size and larger wheels probably may cause serious vibration. Manufacturers of grinders all advise against overloading the machine by using a larger wheel than that which they specify.

Large spindles and extra large ball bearings are used extensively on the floor-type machines to prevent vibration. Bearing housings are sealed to retain the oil and to exclude the dirt and dust. In some cases a special oil filter is provided to exclude all abrasive materials. Pulleys are attached to the spindle, usually at some point between the bearings. In another type of machine, the base of the grinder is of a cabinet design and both the motor and the belt are completely enclosed. The motor usually is set on a platform the base of which is constructed in a variety of ways. On several types of machines the motor rests on a platform which swings on pivots. The tension on the driving belt may be adjusted easily by turning a bolt located in the front of the machine. This raises and lowers the motor platform and motor and provides the desired tension. A door usually is provided on one side of the base to give access to the motor. The spindle also may be driven through a chain and sprocket.

The third class of floor-grinder is driven directly by a motor, the rotor of which is built on the heavy steel spindle of the grinder. An automatic push button control is supplied for the machines driven by alternating current motors and manually operated

Fig. 26—Rigidity of the Machine Is an Important Factor in the Design of Grinding Equipment. Fig. 27—Wheels Are Well Protected By Guards

Fig. 28—Special Equipment Has Been Designed To Withstand the Force of Wheels Traveling at 9000 Surface Feet per Minute

Figs. 29, 30, 31—Numerous Methods Are Employed To Drive the Wheels on Floor Type Grinders. One Type of Drive Has the Motor Mounted on the Table of the Heavy Base with the Rotor of the Motor Built Directly on the Heavy Steel Spindle of the Grinder

Fig 32—Grinding Equipment of Various Types Is Used Extensively in Nonferrous Production Shops. Fig. 33—Vibration Is Prevented on Many Types of Machines by the Use of Extra Large Ball Bearings Which Are Sealed in Special Housings To Exclude Dirt

starters are used for the direct current motors. One type of machine driven by a direct current motor is designed so that adjustment of the guards to the wear of the wheel automatically regulates the speed of the motor so that the peripheral speed of the wheel is constant, regardless of the wheel diameter. The manufacturer of this adjustable speed grinder also makes a machine embodying similar features, but driven by an alternating current motor. The speed of the motor is increased in three steps to compensate for the wheel wear. The grinders which are driven with a belt may be adjusted to any required speed. Any diameter pulley may be used on the motor to produce the required speed. One manufacturer provides two speeds by an ingenious arrangement of pulleys whereby the larger telescopes the smaller.

Use Safety Collars

The safety code of the American Engineering Standards committee provides for flanges one-third the diameter of the wheel. However, some manufacturers provide flanges as large as one-half the maximum wheel diameter. Several safety collars are on the market designed to prevent pieces of the wheel from flying in case a wheel breaks. One safety device consists of a tapered wheel and collars which exactly fit the taper of the wheel. Another safety device consists of a metal disk to which has been vulcanized a sheet of specially prepared rubber. When the blotting paper is removed from the new grinding wheel, one of these washers is applied to either side. The rubber then is forced into the porous surface of the wheel when pressure is applied to the flanges. This construction tends to hold the fragments of the wheel in case of a break.

Several types of wheel guards which meet the safety specifications may be obtained. A hood designed to withstand the shocks incident to breaking a wheel will give almost complete protection to the operator. The use of the guard also adds a great factor of safety to the straight sided wheel secured with a straight flange. A proper hood also provides a sufficient factor of safety to permit a greater leeway between the diameters of the flanges and the diameter of the wheels. This makes it unnecessary to make as frequent changes of the flanges as the wheel wears away. An exhaust nozzle also may be attached to the hood to carry off the dust resulting from the grinding operation.

Grinding wheels mounted on a swinging frame are used extensively in foundries, and especially in steel shops, to clean bulky castings. Railway draw bars, frogs and switches, frame castings, locomotive drive wheels and other castings which are too large to clean with the floor grinder, are finished with the swing frame machine. Large alloy steel castings, as are used in railroad work, also are cleaned with that type of equipment. In many cases the grinder is suspended from a monorail so that it may be taken to the work. Several types of swing frame grinders are shown in Figs. 45 to 50.

While a large number of types of swing frame grinding machines are in use, the general design consists of a horizontal arm which is movable in all directions. A special yoke with bearings for the grinding wheel spindle is located at the front end of the horizontal arm while the motor is located at the opposite end. Many of the machines on the market are equipped with ball bearings throughout. Through various arrangements, the horizontal arm is balanced so that the operator handles only a small portion of the total weight of the machine in swinging it about over the work.

Swing frame grinders may be driven either with a belt or through a shaft. One belt-driven type consists of two frames built at right angles. The vertical frame is suspended from the ceiling and the horizontal frame carries the wheel. The motor is mounted on the frame at the ceiling. The belt passes over the pulley on the motor shaft, over idlers located at the hinged junction of the vertical and horizontal frames, and over the pulley on the wheel spindle. The horizontal frame is balanced by a counterweight. A wire rope is attached to the frame at the proper position to give an exact balance. The point of suspension may be adjusted for various sizes of wheels. The wire is passed over pulleys fastened in the ceiling and has weights attached at the free end which are sufficient to balance the weight of the frame and the grinding wheel.

May Use Shaft

Another type of belt-driven swing frame grinder consists of a steel frame with the motor mounted at one end and the wheel at the other. The frame is supported by a hoist or chain attached to the ceiling and secured to a loop on the frame. Usually this loop may be adjusted along the frame to permit a good balance. The hoist or small crane is used to permit the swing frame grinder to be raised or lowered as the work may demand. The motor also may be connected to the wheel by a shafting, thus eliminating the belt and pulleys. This shaft may be enclosed, to protect all moving parts with the exception of the wheel. Where the wheel revolves in a plane at right angles to that of the grinder frame, the motor located at one end of the frame, may be direct connected to the wheel at the opposite end. If the wheel revolves in a plane parallel to the grinder frame, the wheel is driven through a shaft and bevel gears, which are fully enclosed. A radial type swing frame grinder which is supported on a special stand also has been developed. This stand either may be bolted to the floor or may be set on a movable platform provided with wheels. In the latter case, the entire unit is moved about as desired.

Introduces Portable Equipment

Development of portable equipment has increased greatly the use of small grinding wheels in the foundry cleaning shop. Portable hand grinders may be divided into three divisions, namely flexible shaft, electric and pneumatic. In the flexible shaft equipment the shaft may be connected directly to the rotor spindle of the electric motor or the power may be transmitted through a belt and two pulleys. The free end of the flexible shaft usually serves the purpose of a wheel spindle and is provided with flanges and a nut. The flexible shaft units also may be built on a truck and moved about the plant.

Pneumatic grinders are driven either by pistons or by a valve mechanism. In the former type the machine either has three cylinders set 120 degrees apart, each cylinder being provided with its own valve of the piston type, or with six cylinders. The machine assembly consists of the housing, the cylinders and the handle. The machine with a special valve mechanism has two eccentric rotors mounted on a spindle. The valve mechanism consists of sliding blades. A special governor controls the speed of the machine, cutting down the air supply when the machine is running idle.

Portable electric tools have the wheel mounted on the motor spindle or offset from the center and driven through gears. This type of machine usually is equipped throughout with ball bearings, special handles which greatly assist the operator in handling and a case designed to prevent the entrance of dust and dirt. Portable grinders of the three types are used chiefly in the foundry cleaning room to clean irregular shaped castings which cannot be moved easily.

Much of the success of the grinding department depends upon the selection of grinding wheels. While

Fig. 34—Flexible Shaft Equipment May Be Built in Portable Units and Carried to the Work

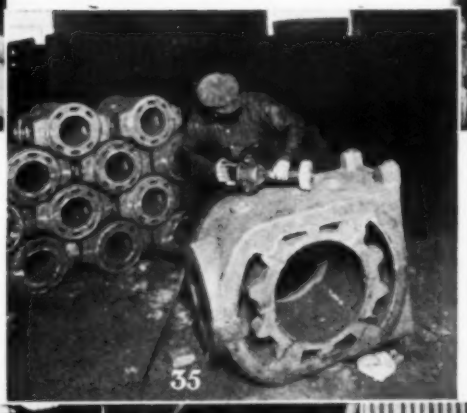


Fig. 35—Portable Tools Are Used Extensively on Large Work Which Is Difficult To Move

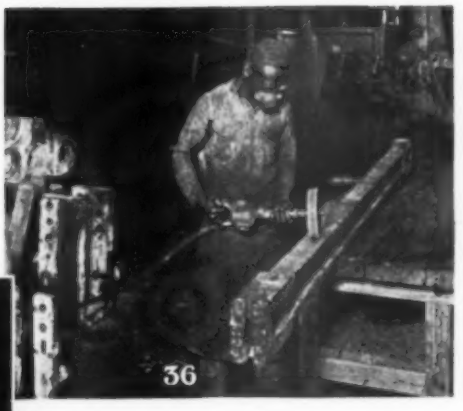
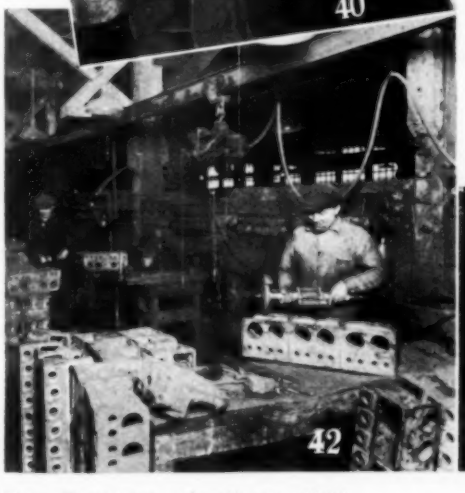


Fig. 36—Pneumatic Tools Are Driven Either by Pistons or a Valve Mechanism

Figs. 37 to 44—Various Types of Portable Electric, Pneumatic and Flexible Shaft Grinding Equipment Are Utilized in Both Ferrous and Nonferrous Foundries. The Equipment Is Built in Units Which May Be Handled and Controlled Easily by the Operator, and Which Remove Excess Metal Quickly and Economically



many variable factors are encountered in grinding castings, manufacturers of wheels have studied the problem thoroughly and now are in a position to give excellent advice to the buyers of their products. Choice of grinding wheels depends largely upon the characteristics of the material to be ground, the size and shape of the casting, the amount of metal which must be removed, the finish desired, the type and condition of the grinding machines, the peripheral speed of the wheel, and the skill of the workman. The characteristics of the grinding wheel may be described completely by giving the abrasive material from which it is made, the grit, grade and the method of bonding.

Large castings as well as rough castings, with large fins and considerable sand and scale, usually require a coarser, harder wheel than smaller castings. The class of finish required controls largely the size of the grit used in the wheel, the finer the finish desired, the finer the wheel which must be used. It generally may be accepted that as the size of the casting increases, the hardness of the wheel also must be increased. Large amounts of stock may be removed faster with a coarse wheel up to the point when the limit of depth to which the grain can penetrate is reached.

The peripheral speed of the wheel is important. If the wheel travels too slowly, a certain amount of abrasive is wasted since maximum cutting action is not secured. In the case of nonferrous metals, the wheel fills up with the metal and loses its cutting edge. If the wheel travels at too fast a speed, the cutting action may be retarded. Excessive speeds also are dangerous. It is advisable to operate the wheel at approximately the speed recommended by the manufacturers, since their recommendations are based upon years of experience and study. Approximately 5000 to 6000 surface feet per minute is the speed usually recommended for snagging castings with a vitrified bonded wheel.

A discussion of the various types of grinding equipment employed in the foundry cleaning room would not be complete without considering the recent developments which have been made in the design and manufacture of high speed grinding wheels and grinding machines. Foundrymen now are beginning to realize that within the physical capacity of the operator, the rate of production in snagging castings is in proportion to the speed of the grinding wheel. Realization of this fact has been due to the pioneer work which has been done by the manufacturers of that type of wheel.

Two distinct types of grinding wheels now are on the market which may be operated at a speed of from 8000 to 9000 surface feet per minute. The rubber bonded wheel for high-speed work first was placed in a foundry cleaning room several years ago and the bakelite or synthetic bonded wheel only recently has become available. Special equipment has been designed to use the high-speed type of wheel, since experience has shown that the great majority of machines now in use in foundry cleaning rooms are not of the proper design to carry the additional burden of the high-speed operation.

While rubber bonded wheels, operating at speeds of 5000 to 5500 surface feet per minute, had been in use in foundry cleaning rooms for many years, the first attempt at high-speed operation of rubber bonded wheels in the foundry was made by an eastern wheel manufacturer. Wheels of relatively soft grades were tried out to remove metal rapidly. The results of the test showed that the total life of the metal and the total metal removed was so low that the wheel cost more than offset the sav-

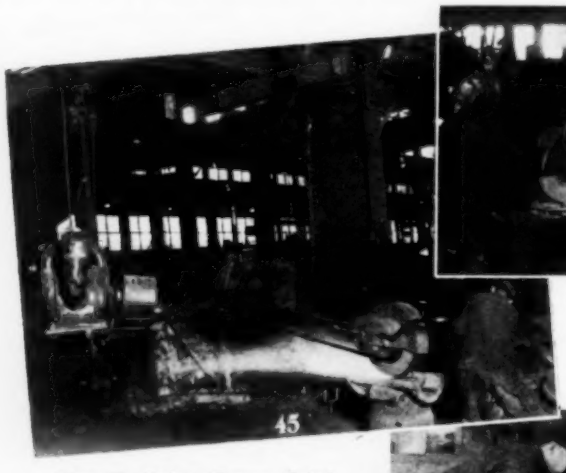


Fig. 45—Swing Frame Grinders May Be Suspended from Monorails

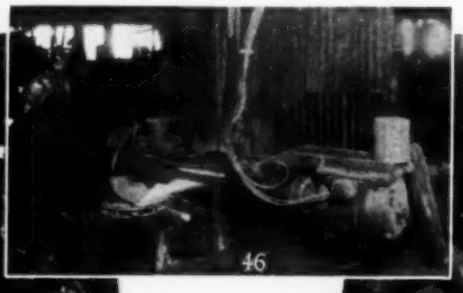


Fig. 46—An Air Filter May Be Used

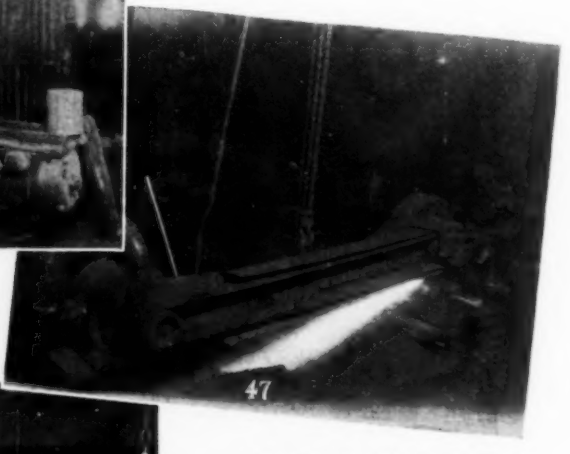


Fig. 47—The Grinder Frame Is Well Balanced

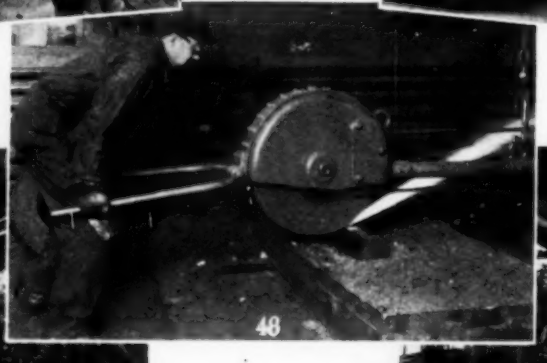
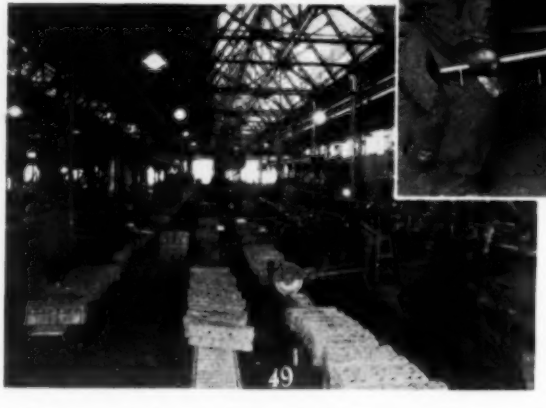
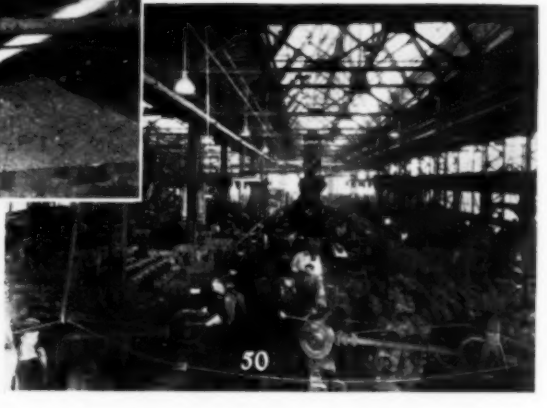


Fig. 48—High Speed Grinder. Figs. 49 and 50—Radial Type Grinders Are Used





ing in labor per pound of metal removed. The company then found that the unfavorable showing was due to the grinding equipment which had been used. It was found that the grinding machines then in use, in most cases, could not supply sufficient power to drive the wheel at the speed for which it had been designed. This slowing up tended to make the wheel act softer than the grade for which it was intended, and resulted in short life. This led the company to study the type of machine best fitted for the work. The first machines brought out were crude compared with the equipment now on the market, but in the main the general principles of design are similar.

Believing that minimum vibration could be obtained by mounting the wheel and the driving medium between the bearings, this feature was incorporated on the first machine and has been followed since. However, this feature added greatly to the difficulty in changing the wheels, especially after ball bearings were adopted. Many types of spindles and bearings were designed and tried and a special ball bearing spindle with a dead shaft finally was adopted. The ends of the shaft, around which the wheel with its flanges and spindle pulley revolve, are anchored securely by hinges incorporated as a part of the wheel guard or grinder head. Ball bearings protected by dust felts, are contained within the wheel mounting. These bearings are not exposed when the wheel is changed.

Manufacturers of bakelite bonded wheels have found that the safe and economical use of that type of high-speed wheel can be accomplished only when the machine equipment is of sufficient strength to withstand the additional strain. The safety feature has been considered carefully in the manufacture of the wheels and one manufacturer has a steel reinforcing ring molded into the wheel where the hole is large. Bakelite bonded wheels 6 inches in diameter and larger are tested at 15,000 surface feet per minute by one company. However, the wheel cannot operate safely unless the machine equipment is suitable.

For that reason one company has designed a complete line of foundry grinding equipment for use with high-speed wheels. For swing frame application a machine has been constructed which consists of a wheel head mounted on and in a steel guard. The wheel is driven by two V-belts, one on either side of the wheel and the wheel flanges are used as belt sheaves. Two sets of railroad type ball bearings are used, both of which are within the hole of the wheel. A quick acting toggle arrangement on the motor mounting bracket releases the tension for making wheel changes.

This is the fifth of a series of articles dealing with cleaning room equipment. The sixth, which will discuss sandblast room equipment, will appear in an early issue.

Brick Door Is Suspended

An interesting example of a home-made charging door for a cupola is shown in the accompanying illustration. It was designed by Fred Grondie, foundry superintendent, Kilby Mfg. Co., Cleveland, and completely fabricated on the premises. A light, curved frame is filled with firebrick and is suspended from three cast iron rollers which travel on a length of

THREE CAST IRON ROLLERS CARRY THE CURVED FIREBRICK DOOR ON A 6-INCH CHANNEL BEAM CURVED TO THE SHAPE OF THE CUPOLA

6-inch steel channel beam. The rollers at each end are double flanged while the center roller is plain. The steel beam follows the curve of the cupola shell from which it is separated by a space of 2 inches except at the two ends where it is secured to the shell by four ¾-inch bolts. The door is pushed around out of the way during the charging period, but is shoved back into place to seal the door opening after the last charge.

The cast iron apron plate shown in front of the door opening is part of the charging equipment. Charges are weighed in flat steel dump pans loaded on small buggies and pushed forward on a track located in the center between two cupolas. The pan is picked up by an air hoist. The nose is placed on the edge of the apron plate and the back end of the pan is lifted so that the charge slides down the apron plate into the cupola. The second cupola which is not shown in the illustration is equipped in a similar manner. Through an opening in the wall, the charging floor extends as a platform 10 feet square into the main bay of the foundry. Charging pans placed on suitable places on the foundry floor are loaded with gates and return scrap, then lifted by one of the cranes and placed on this charging floor extension. A similar method is employed at the back of the charging.

Opens Consulting Office

E. J. Lowry, formerly consulting metallurgist for Hickman, Williams & Co., for the past six years, has opened an office in the General Motors building, Detroit, and will conduct a consulting engineering business. Mr. Lowry attended Annapolis academy for three years, then went to Harvard university and later he attended the Massachusetts Institute of Technology, Cambridge, Mass., where he specialized in metallurgy. Later he became foundry foreman at the United States arsenal, Watertown, Mass., where he gained experience in bessemer and open-hearth melting. He then became associated with the United States Cartridge Co., Lowell, Mass., as metallurgist. Later he became connected with the Oliver Chilled Plow Co., South Bend, Ind. While in the latter position he served as consultant and spent considerable time at plants of the Ford Motor Co., Detroit, the Westinghouse Air Brake Co., Pittsburgh, the Walworth Mfg. Co., Kewanee, Ill., and the Studebaker Corp., South Bend. He joined the Hickman, Williams & Co. in 1922.

Committees of A. S. T. M. Meet in Washington

THE regular spring group meeting of the various committees of the American Society for Testing Materials was held at the Mayflower hotel, Washington, on March 21, 22 and 23. Twenty-six committees of the society took part and with the subcommittees held approximately 94 sessions. Committee A-1 on steel, held a meeting on March 23 at which J. B. Young, engineer of tests, Reading Co., Reading, Pa., was chairman and G. H. Woodroffe, manager boiler tube department, Reading Iron Co., Reading, Pa., was secretary. This committee made several minor revisions in several standard and tentative specifications, some of which are of interest to foundrymen. In the standard methods of chemical analysis of plain carbon steel, proposed methods for the determination of aluminum are being included. Specifications for carbon steel castings for valves were revised to include a table of hydrostatic tests for castings, waiving the annealing requirement after minor welding operations, inclusion of a clause prohibiting the peening of castings to close leaks, inclusion of a requirement that castings shall be clean and changing of time within which rejections shall be reported from 5 to 12 days.

Not Sufficient Demand

Replies to two questionnaires sent by the committee to users of high temperature and high pressure equipment indicate that there is not sufficient demand nor are practices sufficiently standardized to warrant the preparation of a specification for materials for use at 1000 or 1200 degrees Fahr. The subcommittee on steel castings is engaged in the preparation of physical requirements for alloy steel castings.

Committee A-3 on cast iron held its meeting on March 27 under Chairman R. S. MacPherran, chief chemist, Allis-Chalmers Mfg. Co., West Allis, Wis. Hyman Bornstein, director of laboratories, Deere & Co., Moline, Ill., was secretary. This committee put into concrete form the suggested change that has been under consideration of the arbitration test bar and the tension test for cast iron. The proposal contemplates changing the arbitration test bar from a bar 1¼ inches in diameter, tested on supports 12 inches apart, to a bar 1.2 inches in diameter, tested on supports 18 inches apart. It is planned to issue the requirements for the new bar as well as requirements for the tension test specimens as a separate document to be referred to in several specifications for cast iron, including those for gray iron castings (A-48-18), cast iron soil pipe and fittings (A-74-18) and high test gray iron castings (A-88-24). An announcement was made of a paper to be presented by J. B. Kommers, associate professor of mechanics, University of Wisconsin, Madison, Wis., on fatigue tests of cast iron. This paper will be presented at the annual meeting of the society in June and will include results of tension, transverse, impact and fatigue tests. Under the auspices of the committee a series of tests to determine the relation between the properties of specimens cut from iron castings and the properties of separately cast test bars from the same heats were conducted. Results of the tests which have been made by Jesse L. Jones, Westinghouse Electric & Mfg. Co., East Pittsbugh, Pa., will be embodied in the committee's annual report to be presented at the annual meeting to be held in June.

Committee A-5 on corrosion of iron and steel held its meeting on March 22 under Chairman J. H. Gibboney, chief chemist, Norfolk & Western Railway Co., Roanoke, Va., and James Aston, department of mining and metallurgy, Carnegie Institute of Technology, Pittsburgh, secretary. New specifications covering zinc coated barb wire and zinc coated steel wire strand were presented at the meeting. Preparation of a specification covering zinc coated highway guard wire and chain length guards are under consideration by this committee. A subcommittee has been at work formulating methods of accelerated tests. Further results of value have been obtained from the sheet exposure tests, and corrosion tests are well under way on zinc coated products which are being exposed at Sandy Hook, Key West, Fla., Altoona, Pa., Pittsburgh and State College, Pa.

Accuracy of the standard method of sampling coal is being made by a subcommittee of committee D-5 on coal and coke. The subcommittee is co-operating with the prime movers committee of the National Electric Light association, and the bureau of mines. Samples of different grades of coal are being taken by the standard method and analyzed by the standard analytical methods to secure sampling tolerance data. Standard specifications for foundry coke is under consideration for revision. A joint committee of the American Society for Testing Materials and the American Foundrymen's association will give consideration to desirable revision for these specifications. Arrangements have been made for a further discussion of this subject at the Philadelphia convention of the American Foundrymen's association during May 14 to 18.

Make Progress on Pipe

On March 23 the sectional committee on specifications for cast iron pipe met under Chairman T. H. Wiggin, consulting engineer, New York, Vice Chairman N. F. S. Russell, United States Cast Iron Pipe & Foundry Co., Burlington, N. J., and Secretary C. C. Simpson, Consolidated Gas Co., New York. This committee is divided into three groups of which technical committee No. 1 is studying dimension of barrels of sand cast pipe, bell and spigot dimensions, and fittings for all types of cast iron pipe. Technical committee No. 2 on metallurgy, processes and tests is making excellent progress in physical tests of pipe and pipe materials at the University of Illinois under supervision of M. L. Enger, chairman. Technical committee No. 3 on corrosion and protective coatings reported on various aspects of corrosion and protective coatings, with particular reference to a valuable series of corrosion tests being made at the Massachusetts Institute of Technology, Cambridge, Mass.

The joint advisory committee on corrosion consisting of appointed representatives of committee A-5 on corrosion of iron and steel, and committee B-3 on corrosion of nonferrous

metals and alloys, and functioning as as an advisor to the executive committee and correlating the activities of the two committees, recommended that a new standing committee be appointed to study the alloys of the iron-chromium-nickel system. This committee is to have adequate representation from both producing and consuming interests, and study all the properties of the alloys in this system.

Joint research committee of the A. S. T. M. and the A. S. M. E. on the effect of temperature on the properties of metals also held a meeting coincidentally with the group meeting at Washington on March 22. G. W. Saathoff, chief construction engineer, Henry L. Doherty & Co., New York, was chairman of the meeting and F. M. VanDeventer, of the same firm, was secretary. This committee reported that further progress has been made in the co-operative laboratory work. In addition to further reports on short time tests, one laboratory has submitted its report on flow tests. An attempt will be made to co-ordinate the results from the short time and flow tests. It is expected that laboratory work on fatigue at elevated temperatures and thermal conductivity will be under way in the near future. A bibliography prepared by this committee will be available to the public in a few weeks.

Joint committee on the investigation of the effect of phosphorus and sulphur in steel met under Chairman G. K. Burgess, bureau of standards, Washington, and C. L. Warwick, American Society for Testing Materials, Philadelphia, secretary. Discussions of the effect of residual sulphur in forging steels and the effect of residual phosphorus in casting steels were made. In that dealing with cast steel, samples of open hearth, acid steel of two classes have been prepared, as mentioned in the April 1 issue of THE FOUNDRY. The specimens were heat treated at the bureau of standards; some were annealed, others normalized, and the remaining specimens normalized and drawn. Both groups of material have been sent to the government laboratories at Watertown arsenal and the United States naval experiment station. These laboratories will conduct independent tension, hardness, impact, torsion and bending tests.

Advocates a Publicity Program

By H. J. Roesch

TO ATTRACT boys to your plants, it is necessary to educate them as to the opportunities which are present to a young man, skilled in the theory and practice of the art of molding. What have you to offer: A good living, promotion to executive and managerial positions, and an opportunity to go into business for himself? Tell him how the molder works. Point out the interesting feature of the trade. Indicate what he should know about science, chemistry, metallurgy, and the art of handling men, materials and machinery. In what kind of homes do the molders live? Do they save any money? Do they own their own homes? How do they rank with other tradesmen? Why is the occupation important? What is the future of the trade? What are the working conditions? What are the necessary physical and personal qualifications? What tools and materials does he use? Tell him how you are going to teach the trade and then stick to everything you have said.

Establish Districts

The Chicago branch, National Metal Trades association, has been actively engaged in promoting apprenticeship since October, 1926, when a director of apprenticeship was engaged to devote full time to the work. A survey of the needs for apprenticeship was made, and the results were astounding. Eleven districts were formed, by grouping the membership plants geographically for the purpose of efficient handling. Each district includes a residential section, and is accessible to a technical high school. This was done to minimize the number of educational and personal contracts which are being made, and reduces the amount of effort which would be necessary in a city-wide program. When we found what we needed, what we had to offer, and most important, what we could and would do, we wrote a pamphlet setting forth all these things, which we are backing up. This pamphlet is furnished to the key persons in the educational system. It is now being used as vocational guidance material in the schools located where we are promoting apprenticeship.

This article is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association. Mr. Roesch is director of apprenticeship, Chicago branch, National Metal Trades association.

Apprenticeship talks are given periodically in the schools by the apprenticeship director of the Chicago branch. The interest shown by the students is most gratifying. After these talks, applicants come to the office where the apprenticeship system is explained to them and they are given the promotional literature. At the present time we have a number of high school graduates waiting to serve apprenticeships in one of the nine trades which we are teaching.

The secret back of this is that we are offering each boy an intensive, practical, industrial education coupled with one full day of related instruction in one of the city's continuation schools. The wage is incidental to his training. Each employer appoints someone to be definitely responsible for the supervision of the boys in the shop. It is his duty to see that they are advanced according to the schedules contained in their contracts. A monthly report is sent to the parents to maintain their interest in the welfare and progress of their son.

Show Parents Conditions

The boys, when hired, must be accompanied by either parent. This is done to show their parents under what conditions their son will be for the next 3 or 4 years. The minimum age required is sixteen. The boy must have the equivalent of an eighth grade education. Graduates of a 4 year technical course are eligible to receive a credit of one year on their term. Graduates of a two year technical course are eligible for a credit of six months. Boys with previous shop experience are given credits at the discretion of the company. Graduates of an apprenticeship are presented with a bound pocket record of their training, certifying them as journeyman mechanics. The apprentices are now

attending classes in related instruction at the Washburne continuation school for a full day each week.

Most school systems in the country make some provision for disseminating to their students such information about industry and trades as they can obtain. In Chicago this activity is taken care of by a separate department called the vocational guidance department, which is responsible for publishing information about the various trades, and sponsors lectures on industrial information. These people are anxious to work with us, as they know that the great bulk of students will enter industrial pursuits upon leaving school. They have the interest of the boy and girl at heart and are ready to give a helping hand to start these young folks on the right road to becoming responsible citizens of the future.

Here is the activity around which you should build your publicity work. It is an educational program which must be spread through the schools in order to become successful. It cannot be accomplished over night.

Foundrymen alone cannot succeed in popularizing apprenticeship. To be successful, it must be carried out on a larger scale. Every trade or craft is suffering from the scarcity of skilled men.

We should be ready and willing to help the building trades or any other group which is sponsoring an apprenticeship program. Boost their system and they in turn will boost yours. Get behind any bonafide industrial educational movement and give it your whole-hearted support. We must think in terms of apprenticeship. Talk apprenticeship to your neighbor and your competitor. It is only by constant striving to reach a goal that we can hope to attain it.

Make it your business to ascertain what is being done in regard to industrial education in your local schools. If your state is engaged in promoting vocational education, it can be of service to you through this activity. Organize the foundrymen in your community for the purpose of promoting apprenticeship. Inform your local school men as to the opportunities for young men in your plants. Solicit the aid of your state vocational education department in promoting the work, and help them with their problems. Keep everlastingly after it and in time you will find that parents will again be willing and eager to have their sons learn a trade. Bring the mechanic to the same social status of the office or bank clerk, and your problem is on the road to a correct solution.

Twenty years ago an apprenticeship was more or less an accepted fact. The advent of automatic machinery did away with the necessity of learning a trade in order to earn a good wage. Apprenticeship has been on the decline for years and we must be everlastingly hammering away at it now, if we wish to again place it on the same level as it was when we learned our trades.

Penton Paper Wins Award

An article published last April by *Daily Metal Trade*, a Penton Publication, on the unsound price situation in the sheet metal industry won honorable mention for that paper when the first annual awards for editorial achievement by members of the Associated Business Papers Inc., New York, were made Monday at the National Conference of Business Paper Editors. W. S. Doxsey is editor of *Daily Metal Trade*.

H. L. Southal, editor of *Hardware & Metal*, published by the McLean Publishing Co., Toronto, Ont., was presented with a $500 prize for an article exposing rebating to oil companies.

Postpones Closing Date

Milwaukee Foundry Equipment Co., molding machine manufacturer, which is offering $100 in cash for the best suggestion for increasing foundry tonnage, has postponed the date of closing its contest to May 31, 1928.

Association Program Recalls Pittsburgh Old Timers

BENJAMIN D. FULLER, past president of the American Foundrymen's association, and at present representative in the Cleveland district for the Whitehead Bros. Co., Providence, recently came across an old program of the Pittsburgh Foundrymen's association which will possess many points of interest for old timers. A copy of this program of a memorable meeting 23 years ago is shown accompanying.

Of the men listed as speakers at this meeting Mr. Fuller, W. H. McFadden, S. D. Sleeth, J. S. McCormick and H. E. Field still are factors in the industry. J. S. Seaman, familiarly known as Daddy Seaman, one of the stalwarts of the foundry industry, died a number of years ago.

The character of this program and the personality of the men named have left their print upon the work and activities of the Pittsburgh Foundrymen's association, long one of the most active and valuable of the local groups in the industry.

PROGRAM.

Pittsburg Foundrymens'

Association.

MAY 1, 1905.

—CONFESSIONS—

"Inside History of the Roll Industry".....J. S. Seaman.
"How to manufacture Charcoal Iron Car Wheels without Charcoal Iron".....A. W. Slocum.
"How to operate a Foundry in a Hay Loft".....B. D. Fuller
"How to Finance a Program Committee".....F. H. Zimmers.
"Inside facts of why I favor the Blower".....William Yagle.
"Guiding the Water Wagon".....W. H. McFadden.
"A continuous performance Foundry".....S. D. Sleeth.
"Philanthrophy—Or why I give my profits to the Foundrymen".....J. S. McCormick.
"The Molecular Antithesis as affected by the Atomic Theory and its application to the 'Molders' Delight".....H. E. Field.
"Pyrometric Determinations of a Molder's Cranium 'The day after'".....S. H. Stupakoff.
"How I developed the Southern Foundry Iron Industry".....E. A. Kebler.
"Picking Strawberries by the Wayside and my Trip to the Moon".....D. J. Thomas.

WHAT OTHERS ARE THINKING

Abstracts Selected from the World's Foundry Literature

Cleaning Malleable Iron

Malleable Cast Iron, by M. Guédras. *La Revue de Fonderie Moderne*, Paris, Jan. 25, 1928.

This is the last article of the series, which started in March, 1927. The author takes up the subject of cleaning. He emphasizes the point that grinding operations should be effected before the heat treatment, not after as is usually done on the continent, because the heat developed during grinding is sufficient to create hard spots, especially in black heart malleable. The objection to grinding before heat treatment is the heavier wear of the grinding wheels, but it is recommended to use carborundum wheels, as done in American practice.

Great precautions should be taken in straightening the castings, and it is specially recommended that when a casting is heated prior to the operation, it should not be in contact with the fuel or the gases. Sometimes an additional heat treatment will improve the iron. The author then summarizes the various operations of the manufacture of a malleable casting in the order in which they should be effected.

The article ends with the author's view on verification and testing. A test piece devised by Marcel Remy, of Herstal, for the primary metal, is composed of three cylinders of different diameters. The speed of cooling of each cylinder is different, and when the test piece is broken an idea of the silicon contents is obtained from the aspect of the fracture, according to its graphitization. It is necessary, however, to perform a final chemical analysis as well.

Makes Semi-Steel

The Manufacture of Steel-Mix Gray-Irons with Special Reference to Their Treatment in the Foundry, by Arthur Smith, *Foundry Trade Journal*, London, Feb. 2, 1928.

The author states that by the adoption of suitable mixtures and correct melting technique, it is possible to make gray iron castings containing 30 to 60 per cent steel in the mix which will be almost entirely pearlitic in structure. The cupola should have a straight lining with a tuyere ratio to melting zone of 1:6. The author also advocates tuyeres that may be shut off from the wind box. Also the air blast should be measured by a pitot tube to obtain the volume. He then gives data for guidance in making mixtures for various purposes and states that the total carbon should be from 2.9 to 3.2 per cent; silicon for large castings, 1.0 to 1.3 per cent, medium, 1.3 to 1.7 per cent, medium light, 1.7 to 2.2 per cent, light, 2.2 to 2.8 per cent; phosphorus, 0.2 to 0.4 per cent; sulphur, may run up to 0.25 per cent in high steel mixes, but if poured at high temperature and enough manganese added no trouble ensues; manganese, 0.8 to 1.2 per cent.

A well to hold at least three charges is advocated to obtain uniform iron. Manganese is added as high manganese pig or as ferromanganese. Co-operation between the foundryman and the metallurgist is necessary as the molds must be gated and fed properly to obtain good castings. The article also contains several tables giving data on analysis and physical properties of steel-mix and other gray cast irons.

Cooling Affects Structure

The Transformation in Time of Cast Iron, *La Revue de Fonderie Moderne*, Paris, Jan. 25, 1928.

When cast iron cools, the structure tends to vary as the temperature decreases. When the iron is solidified, the crystals that should correspond to the final temperature take some time to form themselves. When cooling is slow the iron has time to take its stable form, but when cooling is rapid the final structure is not formed when the iron has reached its final temperature, and the volume of the metal will continue to change for some time. This is particularly noticeable in castings that present parts of unequal thickness. The phenomena should not be confused with internal tensions due to shrinking.

The change of volume is generally not sufficient to be harmful, but if it is desired to avoid it, while not being able to effect slow cooling, heat treatment can be resorted to. It is sufficient to bring the casting to a temperature of 760 degrees Cent. (1400 degrees Fahr.) and then let it cool gradually. Otherwise it is necessary to let the casting age for a period ranging from two weeks to several months. Quicker results are obtained by placing the casting in the sun, provided that every part is exposed in turn. The formation of rust also activates the process.

Discusses Shrinkage

Shrinkage Holes in Small Gray Iron Castings, by P. A. Russell, *Foundry Trade Journal*, London, Jan. 26, 1928.

The various factors entering into the cause of shrink holes in small castings are described by the author and he gives a number of examples and the methods for preventing their occurrence. His conclusions are as follows:

The cause of drawing in gray iron castings is that the expansion due to formation of graphite is practically all absorbed in expanding the outer shell of the casting, and the remaining liquid shrinks. The amount of drawing in a casting is governed by the following, the conditions stated being those which tend to reduce the amount of drawing: (a) The composition of the metal (low silicon, low phosphorus, high manganese and medium total carbon are ameliorative); (b) rapid uniform freezing of the metal as governed by the mold size and conditions; (c) the feeding of fresh liquid metal into the casting by means of runners and risers, and the increased efficiency of these due to high casting temperatures, and (d) the provision of means for the ready escape of the mold gases.

Performs Experiments

"Heredity of Cast Iron." Abstract of a report presented by A. Le Thomas before the Academy of Science. *La Revue de Fonderie Moderne, Paris*, Feb. 10, 1928.

Certain cast irons show exceptional mechanical properties although their chemical composition is the same as that of other irons that give much less satisfactory results. This particularly is noticed, for instance, in cold-blast iron, which gives castings with a high tensile strength. When such exceptional irons are remelted, their qualities are preserved. The scientific explanation of the paper believes that the heredity is due to the fact that the graphite lamellae pre-existing in the iron remain in a condition of surfusion during the short time the metal is in a molten state, owing to the rapid passage of the high temperature. However experimental proofs of this theory still have to be effected.

The following experiment made by the author was not conclusive. He melted gray iron with a pearlitic structure in a crucible, cast one portion of it as a large block in a warm sand mold, and poured the other portion in small chilled molds, thus obtaining two widely different conditions of cooling. The composition of the iron was: Total carbon 3.25 per cent, combined carbon 0.73 per cent, silicon 1.42 per cent, manganese 0.52 per cent, sulphur 0.06 per cent, phosphorus 0.27 per cent. The casting obtained in the hot sand mold contained a large portion of graphite, whereas the other small castings were chilled. Both castings then were remelted in separate crucibles but in the same furnace and at the same temperature, and test pieces then were taken from each crucible, the diameter of the test pieces being 20 millimeters (0.787 inches). The test pieces were poured in dry sand molds. The two types of test pieces were submitted to a series of tests, mechanical, micrographical, chemical analysis, and dilatometric tests, and both series gave practically the same results; showing that the resulting products were almost identical.

This experiment tends to prove that the final product, when cast under normal conditions, was influenced not by the immediately proceding process, where special conditions obtained, but by the original state. Furthermore, the author investigated the conditions of the graphite in a piece that had been cast in a chilled mold and had not been remelted, and he found only a small number of lamellae in the center of the piece.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ 32 Years of Progress

FOUNDRYMEN have convened in Philadelphia on three previous occasions. First in May, 1896, when a national organization was formed to take over and correlate most of the work formerly handled in various sections of the country by local associations of foundrymen. The second meeting was held in May, 1907, when every business, including that of manufacturing castings, was at a decidedly low ebb. Many foundrymen, due to gloomy business outlook failed to attend that meeting. They were convinced nothing could be done. Holding a meeting was just an idle gesture. Time rolled along as time has a habit of doing and the foundrymen once more, for the third time gathered together in the city of Philadelphia in September, 1919, with the war time business rolling toward the peak.

NOW for the fourth time the American Foundrymen's association will hold its annual convention and exhibition in the arcadian city founded by William Penn on the western bank of the Delaware. A considerable volume of water has flowed down to the sea between the banks of that same river and it is only natural to find that many changes have taken place in the personnel and activities of the American Foundrymen's association in the comparatively long period of 32 years. The basic aim and object, to advance the technical status of the industry, never has changed. Presentation of papers from scientific and practical angles has gone hand in hand with exhibition of equipment for increasing production and quality and reducing the cost.

THOSE who are privileged for the first time to attend the present convention of the American Foundrymen's association will be astonished at the activities sponsored by this body and the scope on which the annual convention and biennial exhibition are operated. Veterans who have attended one, two or even three former conventions will realize how solidly the association is established. It was founded by a small group of enthusiasts about the time manufacturers were beginning to peep timidly out of their shells and swap a little trade news with each other. It survived the panic of 1907 and the almost equally disastrous inflation of 1919 and 1920. From present indication the 1928 convention and exhibition will attain a new high record in attendance, in interest, in volume of display and in the high character of the papers presented for discussion.

¶ Abolish the Joker

WHAT peculiar ingrained mental twist or quirk turns men who have reached, or presumably have reached, the age of discretion into irresponsible, havoc wreaking creatures known far and wide as practical jokers? Industry and the world at large would be benefitted it this form of dementia could be eradicated. A great hue and cry is raised about the corn borer and large appropriations are given to exterminate other predatory insects—but the practical joker seems to go on forever.

A RECENT report of accidents submitted to the department of labor and industry of Pennsylvania shows that this alleged form of wit was responsible for several deaths and a number of serious accidents. In a foundry at Hamburg, Pa., a practical joker attached an electric wire to a fellow worker's dinner pail which resulted in the death of the owner of the pail. Another scatter brain lighted a piece of waste hanging from a garage employe's overalls. The waste was saturated with gasoline and his overalls with grease and the ensuing fire resulted in serious burns to the wearer.

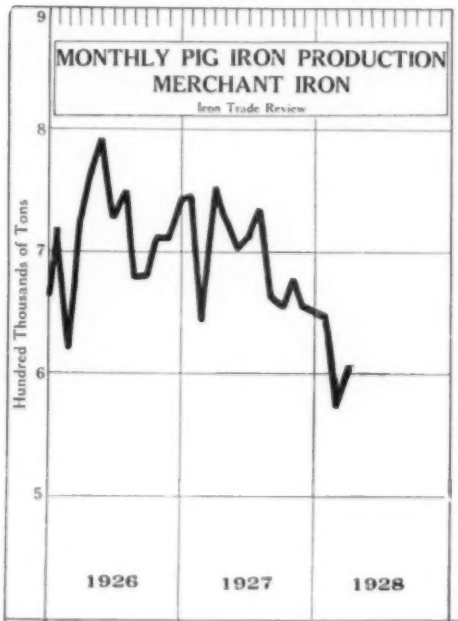
THEN there is the smart aleck who always thinks he is the life of the party, pulling chairs from under people, placing tacks on chairs, and originating no end of electrical pranks. Also in the shop he is the first to suggest hazing the new man. What can be done to make industry safe from the practical joker? Largely it is up to industry to put a ban on this sort of accident making. Shop discipline should forbid this form of harmful playfulness and visit it's appearance with prompt punishment.

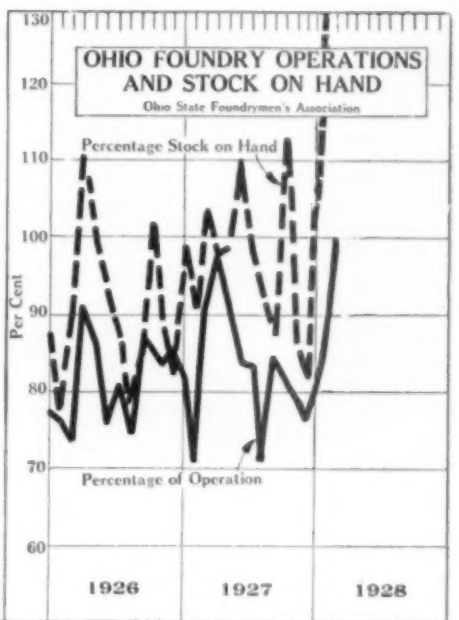
Trade Trends in Tabloid

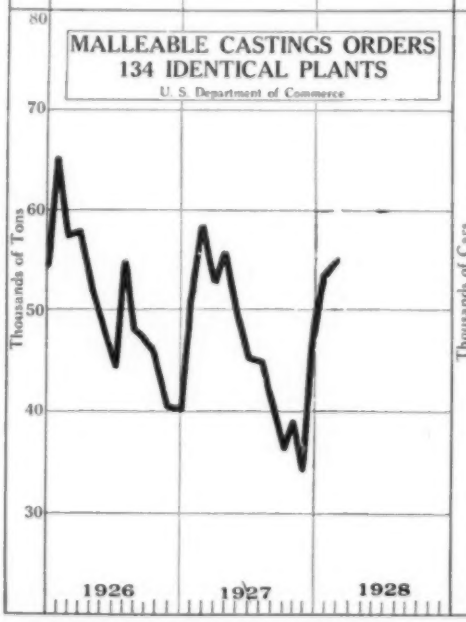
ALTHOUGH no general jobbing foundries are turning away business, the average conditions in the foundry industry are much improved, with fair prospects for the next few months. Building contracts still stand at a high total. Automotive production has shown a steady advance since the first of the year, and time orders for steel and other commodities used in automobile manufacture indicate optimism as to late spring sales. The output of foundries in eastern Pennsylvania increased 7.6 per cent in February, compared with the preceding month. Operations continue at a high rate throughout Ohio. Implement business in Illinois is improved. The melt of foundries in the St. Louis district is heavier than at any time since the first of the year. Production of all classes of pig iron gave March a total of 3,208,281 tons, compared with 2,898,668 tons for the preceding month. On a daily average basis, March was 3.54 per cent ahead of February, according to *Iron Trade Review*. Merchant iron output totaled 606,057 tons in March as against 579,598 tons for the previous month. Average monthly prices for nonferrous metals according to New York quotations in the *Daily Metal Trade* follow: Casting copper, 13.801c; electrolytic copper 14.104c; Straits tin, 52.174c; lead, 6.014c; antimony, 10.163c; aluminum, 23.90c. Zinc averaged 5.629c, E. St. Louis, Ill.

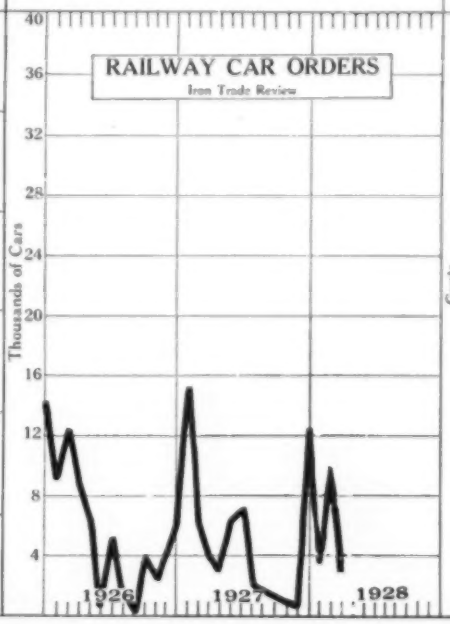
RAW MATERIAL PRICES
April 7, 1928

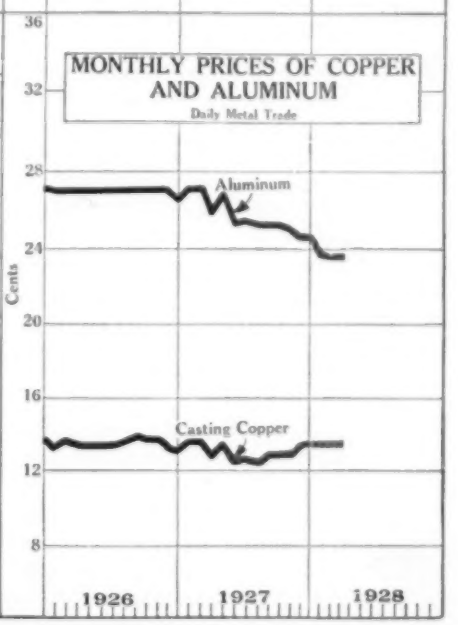
Iron	
No. 2 foundry, Valley	$17.25
No. 2 southern, Birmingham	16.00
No. 2 foundry, Chicago	18.50
No. 2 foundry, Philadelphia	20.76
No. 2 foundry, Buffalo	17.00
Basic, Valley	17.00
Basic, Buffalo	17.00
Malleable, Chicago	18.50
Malleable, Buffalo	17.50
Coke	
Connellsville foundry coke	$3.75 to 4.25
Wise county foundry coke	4.00 to 5.00
Scrap	
Heavy melting steel, Valley	$14.50 to 15.00
Heavy melting steel, Pitts	14.50 to 15.00
Heavy melting steel, Chicago	12.75 to 13.00
Stove plate, Chicago	11.50 to 12.00
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	14.50 to 15.00
No. 1 cast, Philadelphia	16.50 to 17.00
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	14.00 to 14.50
No. 1 cast, Buffalo	12.75 to 13.25
Car wheels, iron, Pittsburgh	14.25 to 15.00
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	12.75 to 13.00
Agricultural Mal., Chicago	11.75 to 12.25
Malleable, Buffalo	15.00 to 15.50
Railroad malleable, Pitts	14.25 to 14.75
Nonferrous Metals	Cents per pound
Casting copper, refinery	13.90
Electro copper, producers	14.25
Straits tin	52.62½ to 52.75
Lead, New York	6.10
Antimony, New York	9.50
Nickel, electro	37.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 17.50
Zinc, East St. Louis, Ill.	5.75 to 5.77½











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

WALTER H. PFEIL has been appointed roll foundry superintendent of the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa. Mr. Pfeil has devoted the greater part of his life to metallurgical work in the iron and steel industry. He received his education at the Colorado School of Mines Golden, Colo., and the Carnegie Institute of Technology, Pittsburgh. His early experience in a roll foundry

CHARLES R. McGRAIL

was obtained at the Lewis Foundry & Machine Co., Pittsburgh. Later he built the roll department of the Standard Engineering Co., Ellwood City, Pa., and remained with that company for five years. He then became connected with the Farrel Foundry & Machine Co., Ansonia, Conn., where he served as metallurgist for two years. During the past seven years he has been chief metallurgist and roll foundry superintendent of the Hubbard Steel Foundry Co., East Chicago, Ind.

Charles R. McGrail has been appointed chemist and metallurgist at the Sheffield Works of Fairbanks, Morse & Co., Three Rivers, Mich., having charge of melting. Mr. McGrail was born in Worcester, Mass., and received his technical education at the Carnegie Institute of Technology, Pittsburgh. During the summer of 1922 he worked in the core room of the Westinghouse Air-Brake Co., Wilmerding, Pa., and with the exception of the summer of 1926 when he took a special course at the University of Michigan he spent the summer vacation periods in the engineering department, core room, pattern shop and foundry of Fairbanks, Morse & Co. Upon completing his engineering course in 1927 he became connected with the latter company.

E. C. Black, formerly metallurgist for the West Michigan Steel Foundry Co., Muskegon, Mich., has been made metallurgist for the Edward Valve Co., East Chicago, Ind.

Stanley P. Benton has been elected president of the E. D. Jones & Sons Co., Pittsfield, Mass., manufacturer of paper making machinery, succeeding the late Edward A. Jones.

W. H. Bowden, Maytag Co., Newton, Iowa, will address the Quad-City Foundrymen's association at a meeting to be held in the LeClaire hotel, Moline, Ill., April 16. Mr. Bowden will speak on "Foundry Operations at the Maytag Company."

William O. Lange has been elected secretary of the Phoenix Iron Co., Philadelphia, succeeding the late George Gerry White, who had filled the office for 58 years. Mr. Lange has been with the Phoenix company for more than 23 years, during the past two years as general manager of sales.

J. W. Haynes has been made foreman of the North Western Foundry Co., Chicago. He formerly held a similar position with the Plano Foundry Co., Plano, Ill.

John G. Platt as been elected president and general manager of the Hunt-Spiller Mfg. Corp., Boston, succeeding the late Walter B. Leach. Mr. Platt has been vice president in charge of sales and operations since 1917.

C. E. McCampbell for the past 14 years foundry superintendent of the Gisholt Machine Co., Madison, Wis., recently resigned. Mr. McCampbell was born in Indiana and received his education at Wabash college, Crawfordsville, Ind. He then served an apprenticeship at the Rockwood Mfg. Co., Indianapolis, and later completed a technical course covering various stages of foundry practice including the metallurgy of cast iron. He later was connected with the Marmon Co., Indianapolis, and then became foundry superintendent of the Chain Belt Corp., Milwaukee.

EDWARD E. MARBAKER

Gray Iron Meeting To Be Held May 18

THE committee of fifteen appointed by the Pittsburgh conference of gray iron foundrymen held March 13, has arranged a meeting open to all interested manufacturers of gray iron castings. The meeting will be held in the convention hall of the Philadelphia Commercial museum, Friday, May 18 at 10 a. m. This will be the closing day of the American Foundrymen's association convention and no technical session of interest exclusively to the gray iron branch has been set for that day.

Makes Appointment

Recently the Whiting Corp., Harvey, Ill., manufacturer of foundry equipment, has established an industrial fellowship on cast iron at the Mellon Institute of Industrial Research, Pittsburgh. Dr. Edward E. Marbaker has been appointed to carry out the investigations. Dr. Marbaker was graduated from the Towne Scientific school, University of Pennsylvania, Philadelphia, in 1910 with the degree of bachelor of science in chemistry. In 1914 he received the degree of doctor of philos-

ophy from the graduate school of the same institution. He first worked for the Westinghouse Lamp Co., carrying on investigations in platinum metals. Later he became chief chemist and had charge of the metallurgical laboratory.

In 1917 he became connected with Alexander Bros., as chief chemist and later as chief engineer. From 1920 to 1921, Dr. Marbaker was chief chemist for the Cleveland wire division, National Lamp Works, Cleveland. Since 1921 he has been a fellow at the Mellon institute conducting various chemical and metallurgical research works. From time to time he has contributed articles to technical publications. Dr. Marbaker is a member of the American Chemical society, American Ceramic society, American Institute of Chemical engineers, Franklin institute, and the American Foundrymen's association.

Obituary

William Cameron Sproul, organizer and developer of numerous iron, railroad, mining, traction and power enterprises, and former governor of Pennsylvania, died at his home near Chester, Pa., March 21. He had been ill many months following an attack of pneumonia. He was 57 years old. Mr. Sproul engaged in newspaper work for some time after his graduation from Swarthmore college. In 1900 he organized the Seaboard Steel Castings Co., Chester, Pa., sold to the Penn Seaboard Steel Corp. in 1916, and since 1917 owned by the American Locomotive Co. In the same year he organized the Chester Shipping Co. for water transportation. In 1909, with a number of associates, he organized the General Refractories Co., now one of the largest interests making fire brick, with 15 plants in Pennsylvania, Illinois, Maryland and Kentucky. He was chosen president and a director of this company and at the time of his death was chairman of the board. He also was chosen president of the Lebanon Valley Iron & Steel Co., which in 1920 became the Lebanon Iron Co., and in 1924 he was made chairman of the executive committee. In 1916 he purchased the old Robert Wetherill works in Chester and turned this over to the Sun Shipbuilding Co., in which he retained a large interest. He became president of the Lackawanna & Wyoming Valley Railroad Co., director of other transportation enterprises, and was interested in many banking and insurance companies.

William Blackwood Smith, president, Smith & Caffrey Co., Syracuse, N. Y., died March 24 at his home in Syracuse. Mr. Smith was born in Willimatic, Conn., June 22, 1860. As a boy he removed to Syracuse, N. Y., with his parents where he attended the public schools and later completed a business course. He started his business career in 1880 with the E. C. Stearns Co. as salesman, and after a number of years of successful work decided to enter business for himself.

In 1893 he formed a partnership with James S. Caffrey and founded the firm of Smith & Caffrey of which he was president at the time of his death. This firm manufactures structural steel and also conducts a job-

WILLIAM B. SMITH

bing foundry. Besides his connection with the structural steel industry, Mr. Smith was known as foundry expert. At the time of his death Mr. Smith was the sole owner of the firm, as Mr. Caffrey retired six years ago and Mr. Smith assumed his interest.

Mr. Smith was much interested in the civic and charitable projects of Syracuse and gave much of his time to philanthropic work. He is survived by his widow, one daughter, two sisters and one brother.

William F. M. Goss, who until his recent retirement was for ten years president of the Railway Car Manufacturers' institute, New York, died March 23 at the Waldorf-Astoria hotel, New York, in his sixty-ninth year. Mr. Goss was one time professor of railway engineering and dean of the college of engineering, at the University of Illinois, and prior to that dean of engineering at Purdue university. He had been in poor health for some time. Burial was at Barnstable, Mass., his birthplace.

Harry L. Bell, 70 years old, died at his resort home at Bass Lake, near Knox, Ind., recently following a long illness. For years Mr. Bell was superintendent of the foundry department of the Dodge Mfg. Corp., Mishawaka, Ind., maker of pulleys, shafting, etc., and was an expert metallurgist.

William Melville Bowman, president, Somersworth Foundry Co., Salmon Falls, N. H., died recently at his home in that city at the age of 67.

Hold Group Meeting on Gray Iron Problem

At the call of B. H. Johnson, chairman of the committee which scheduled a conference of gray iron foundrymen on March 13, held by agreement at Pittsburgh, arranged a meeting of 30 to 35 gray iron foundrymen in his district for April 12. At this meeting, many of the points to be considered in laying the groundwork of the Gray Iron institute, were discussed. Mr. Johnson is a member of the organization committee of fifteen, appointed at Pittsburgh to launch the institute at a session to be held in Philadelphia, May 18.

Elected President

H. Winterton, manager and chairman of William Cumming & Co., Ltd., Kelvinvale Mills, Maryhill, Glasgow, Scotland, manufacturers of foundry blacking, core compounds, plumbago, and foundry requisites, has been elected president of the Foundry Trades Equipment and Supplies association, succeeding V. C. Faulkner, past president of the Institute of British Foundrymen, who was president of the association since its foundation.

MoveA.F.A.Headquarters

Headquarters of the American Foundrymen's association were moved April 10 from 140 South Dearborn street to the Adams Franklin building, 222 West Adams street, Chicago, where larger quarters have been obtained. After the convention the office of the technical secretary will be moved from 909 West California street, Urbana, Ill., to the new headquarters in Chicago.

C. Warren-Boulton, Calcutta, India, has been selected to represent Osborn Mfg. Co., Cleveland, manufacturer of molding machinery and handling equipment, and W. W. Sly Mfg. Co., Cleveland, builder of sandblast tumbling, and dust arrestor equipment.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Denver, Rio Grande & Western railway, Denver, plans to build a foundry and shops at Salida, Colo. A. O. Ridgwat is chief engineer.

Raymond N. Burke, Newark, N. J., will remodel the building at 15 Contes street for a brass foundry.

Enameled Sanitary Co. will establish its plant at Alliance, O., taking over the foundry building of the Buckeye Jack Mfg. Co.

Spuck Iron & Foundry Co., Fourteenth and Branch streets, St. Louis, has increased its capital stock from $25,000 to $150,000.

Fairbanks Co., Binghamton, N. Y., manufacturer of valves, plans to rebuild that part of its plant damaged by a recent fire.

Breckenridge Foundry & Supply Co., W. S. Slangerup, president, Mineral Wells, Tex., plans to move the plant to Breckenridge, Tex.

Ornamental Brass Shops, Tenth street and Tenth avenue, Rockford, Ill., plans to build a plant addition for the manufacture of hardware, brass and aluminum castings, etc.

Oklahoma City Brass Pipe Co., Oklahoma City, Okla., is inquiring for machinery and equipment for a proposed 1-story foundry to be built on Seventh street.

Nichol-Straight Foundry Co., 319 West Austin street, Chicago, plans to build a foundry, 60 x 70 feet. G. E. Pearson, 400 West North avenue, is architect.

Detroit Gray Iron Foundry Co., 6403 Wight street, Detroit, has awarded the contract for a 1-story addition to its plant, to P. H. Piper, Michigan Theater building. (Noted Feb. 15.)

Acerite Steel Corp., H. J. Hahn, president, 225 West Monument street, Baltimore, has acquired a structure at 46 South Garrison lane, which will be equipped for the manufacture of special alloy castings.

Commonwealth Brass Co., 6781 Commonwealth avenue, Detroit, is inquiring for machine equipment for manufacturing small brass castings, etc., for the planned addition to its plant.

Saginaw Malleable Iron Works, Saginaw, Mich., is inquiring for machinery and equipment for finishing castings for the proposed 1-story foundry and plant 80 x 90 feet and 80 x 110 feet, to be built on Florence avenue.

The item in THE FOUNDRY of March 1 reporting that the United States Cast Iron Pipe & Foundry Co., Burlington, N. J., was negotiating for purchase or leasing of the plant in Billings Park, Wis., is found to be in error.

Twentieth Century Brass Works, Minneapolis, has removed from 518 Fifth avenue, South, to 2601 East Hennepin avenue. The firm recently completed a new foundry and machine shop building and is installing up-to-date equipment for the manufacture of bronze bushings. L. J. Dawson is secretary.

Corpus Christi Foundry & Machine Co., Black and West Broadway, Corpus Christi, Tex., has been acquired by San Antonio, Tex., interests and will be known as the Luckett Foundry & Machine Co. H. L. Luckett is manager of the company. Improvements are contemplated.

Otis-Sawyer Boiler & Foundry Co., Oswego, N. Y., has reorganized into the Sawyer Brass & Iron Foundry Co. and the Otis Boiler Co. The former company will operate the foundry, while the latter will rebuild the boiler department burned in a recent fire. (Noted Feb. 15.)

Manufacturers Brass Foundry, 2723 Poplar avenue, Chicago, recently formed, has started production of brass and aluminum castings. P. Williams is president, B. Y. Craig, vice president; G. P. Edmonds, secretary; F. R. Gear, treasurer, and W. Hunter, general superintendent. (Noted Jan. 1.)

National Cast Iron Pipe Co., Birmingham, Ala., is extending facilities for making de-Lavaud centrifugally cast pipe to 14, 16, 18 and 29-inch sizes. Two bays and a cleaning shed will be built by the Virginia Bridge & Iron Co. to accommodate the new departments. An annealing furnace has been ordered from Ryan, Scully & Co., Philadelphia. A conveyor car for the annealing furnace will be furnished by the United States Cast Iron & Pipe Foundry Co. (Noted April 1.)

Sully Brass Foundry Ltd., Toronto, Ont., is inquiring for machine and equipment for its plant acquired recently.

D. June Machinery & Supply Co., Waco, Tex., has awarded the contract for a foundry to be built at 208 South First street.

Modern Products Corp., Tulsa, Okla., F. B. Paist, manager, plans to build a structure 90 x 360 feet to house a foundry, machine shop and plating plant. Contracts are now being awarded.

New Trade Publications

WELDING—A bulletin by the Wilson Welder & Metals Co., Hoboken, N. J., describes essentials of good welding, as set forth by the technical director of the company. The material is the result of research by the company in perfecting its welding devices. Drawings illustrate the text. Data are given to guide the welder in choice of current value, proper electrode and other factors.

ELECTRIC MOTORS—General Electric Co., Schenectady, N. Y., has issued a bulletin on a type of motor of its manufacture, for alternating current use, with adjustable speed and brush shifting. Details of construction and wiring are given and full data.

MILLING ATTACHMENTS—Porter Cable Machine Co., Syracuse, N. Y., has published a booklet on milling attachments which shows their operation, illustrates various installations and describes what may be done on each type. The tapered-end mills are for pattern work and rotary filing.

ELECTRIC HOISTS—Chisholm-Moore Mfg. Co., Cleveland, has issued a catalog of electric hoists, one of a series on material handling equipment. The general subject of electric hoists is covered, with description of various types of hoists and their use and care. Tables of clearances and dimensions and other data are given.

THERMOSTATS—Robertshaw Thermostat Co., Youngwood, Pa., in a current bulletin outlines advantages of its thermostats for industrial appliances. A wide list of applications is given and remarkable precision of temperature control is shown.

DRUM CONTROLLERS—General Electric Co., Schenectady, N. Y., in a current bulletin, presents a line of drum controllers for series and compound-wound motors used on crane hoists and similar applications. It is illustrated.

HANDLING EQUIPMENT—Stuebing Cowan Co., Cincinnati, has issued a leaflet describing its single side lift truck with ball bearing equipment. Reduction of friction permits larger loads with less effort to move.

NICKEL—A bulletin by the International Nickel Co., New York, presents the practical and economic value of nickel and chromium in gray cast iron. It is illustrated by photomicrographs of various castings with and without the nickel alloy.

ALLOY FORMULAS—Niagara Falls Smelting & Refining Corp., Buffalo, has compiled a book of formulas covering a wide field. Nonferrous mixtures for various purposes, including ancient and modern combinations are presented. A description is given of various metals commonly used in alloys.

CHAIN DRIVES—Hans Renold Ltd., Didsbury, Manchester, Eng., has issued a catalog of standard chain drives. Illustrations show a wide variety of applications and complete engineering data are given.

ELECTRICAL FURNACES—Ajax Electrothermic Corp., Trenton, N. J., has issued bulletin on its motor generator type furnaces and equipment. The text traces the history of electric melting, outlines the principles of operation and shows details of construction and operation.

ELECTRIC PRECIPITATION—General Electric Co., Schenectady, N. Y., is issuing a catalog of electrical equipment for use with a precipitation process for elimination of dust and smoke in industrial plants. A bibliography of the theory of electrical precipitation is included.

PULVERIZERS — Centripact Pulverizer Corp., Denver, in a current bulletin illustrates its pulverizer which reduces hard materials by impact and attrition. Details of the machine and illustrations showing it assembled make clear its construction and operation.

VARIABLE SPEED TRANSMISSION—Reeves Pulley Co., Columbus, Ind., has issued a bulletin calling attention to changes in its variable speed transmission. It is illustrated. A new catalog of the company's products also has been completed.

ROTARY DRYERS—Struthers-Wells Co., Warren, Pa., has issued a bulletin describing its line of rotary dryers, kilns, and coolers of steam heated, hot air, direct heat and indirect hent types.

ROLLER BEARINGS—Rollway Bearing Co., Inc., Syracuse, N. Y. has issued a booklet describing its wide series and utility type roller bearings. The publication is well illustrated and contains engineering information on bearings. Other types of roller bearings manufactured by that company are described in several other publications which also are being distributed.

MOLDING MACHINE—The Milwaukee Foundry Equipment Co., 284 Seventh avenue, Milwaukee, has issued a bulletin giving detailed information on various types of molding machines which it manufactures. The bulletin contains information on plain and jolt squeeze machines, special jolt squeeze machines, jolt squeeze strippers, hand roll over and hand stripping machines, jolt roll over machines, and portable jolt roll over pattern draw machines.